Member A.B.C.—A.B.P.

OCTOBER 1939 • THE *Petroleum* **Engineer** • VOLUME XI NUMBER 1

Published by THE PETROLEUM ENGINEER PUBLISHING COMPANY . . Telephone 2-4571 . . Seventh Floor Allen Building . . DALLAS, TEXAS

A MAGAZINE OF METHODS FOR OPERATING MEN

CLARENCE MORRIS
President and General Manager

J. L. DWYER
Vice-President

W. T. BRYAN
Secretary-Treasurer

EDITORIAL

K. C. SCLATER
Vice-President and Editor

FRANK H. LOVE
Managing Editor

WALLACE A. SAWDON
Pacific Coast and Foreign Editor

H. LEE FLOOD
Associate Editor

ADVERTISING

W. L. LOVE
Vice-President and Advertising Manager

NEW YORK, N. Y.
ROGER MOTHERAL
6830 Burns Street
Forest Hills, Long Island
Telephone: BOUlevard 8-2959

CLEVELAND, OHIO
AXE JONES
3788 West 129th Street

CHICAGO, ILLINOIS
E. V. PERKINS
1053 Pratt Blvd.
Telephone: SHEldrake 6571

TULSA, OKLAHOMA
T. J. CROWLEY
Vice-President
1402 South Owasso
Telephone: 3-4236

LOS ANGELES, CALIF.
R. C. WIPPERMAN
905½ North Fairfax
West Hollywood
Telephone: HEmpstead 1885

CIRCULATION—C. R. BARRETT, *Circulation Manager*

Contents

	Page
DRILLING AND PRODUCTION	
Preliminary Design of Drilling Barge for Deep-Water Prospecting (Part 1) — By ROYDEN H. ROGERS	21
Data on Gas-Driven Pool Disclose Characteristics Differing From Water-Driven Reservoirs — By ALEC M. CROWELL	25
Record of Penetration Rate Should Aid in Drilling-Time Studies — By H. LEE FLOOD	31
Lightweight Pumping Equipment Saves Small-Potential Wells From Abandonment — By W. H. STUEVE	46
REFINING AND NATURAL GASOLINE MANUFACTURE	
The Development of Anti-Knock Motor Fuel (Part 2. Concluded) — By A. W. TRUSTY	34
The Distillation Process of Natural Gasoline Extraction — By ROY W. MACHEN	96
Polymerization of Hydrocarbons Present in Natural Gas — By RAFAEL FUSSTEIG	219
OIL AND GAS TRANSPORTATION	
Determining Minimum Current Required to Provide Adequate Cathodic Protection (Part 1) — By DAVE HARRELL *and* MILTON CLERC	38
Location and Installation of Ground Beds — By D. F. BALL	91
GENERAL	
Alphabetical Subject Index to Decimal System for Classifying Petroleum Engineering Data (Part 2) — By LESTER C. UREN	53
Photoelastic Stress Studies of Various Types of Welded Joints — By KENNETH N. MILLS	84
SPECIAL FEATURE	
This Industry of Ours (Part 2) — By NORTH BIGBEE	67
ENGINEERING NEWS OF INTEREST	
Slump in Barite Sales Offset by Use in Oil-Well Drilling in 1938	48
New Laboratory for Testing Motor Fuels and Lubricants Under Operating Conditions	94
REGULAR DEPARTMENTS	
The Course of Oil	8
Highlights in Oildom	10
Major Pipe Line Activities	12
Activities in the Oil Fields	14
Petroleum Statistics and Field Activities	16
Activities in Refining	18
The Petroleum Engineer's Continuous Tables (Installment No. 28)	51
Laugh With Barney	224
Running Tour With Men in the Industry	226, 228, and 229
Machinery and Equipment	230, 232, 233, 234, 235, 236, and 237
Book Reviews	244
Trade Literature	245
Meetings	249
SPECIAL SECTION ON SOUTH AMERICA	
South America Becomes Increasingly Important in World Petroleum Industry — By WALLACE A. SAWDON	104
New Discoveries Stimulate Interest in Ecuador — By WALLACE A. SAWDON	107
Discovery on Inland Slope of Andes Increases Scope of Peru's Activity — By WALLACE A. SAWDON	115
Brazilian Government Begins Aggressive Exploratory Program — By WALLACE A. SAWDON	126
Recent Developments Have Materially Strengthened Eastern Venezuela's Position — By WALLACE A. SAWDON	130
Color Map of Argentina	150
Color Map of Colombia	154
Color Map of Ecuador	158
Color Map of Peru	162
Color Map of Trinidad	166
Color Map of Eastern Venezuela	170
Color Map of Western Venezuela	174
Refineries on Island of Aruba Incorporate Modern Improvements — By WALLACE A. SAWDON	179
Western Venezuela Maintains Leadership in South America — By WALLACE A. SAWDON	184
World's Longest 16-in. Oil Pipe Line Laid in Eastern Venezuela — By FRANK H. LOVE	193
Excellent Living Conditions Provided Employees in Venezuela — By WALLACE A. SAWDON	198
Colombia's Oil Possibilities Being Actively Explored and Developed — By WALLACE A. SAWDON	205
Petroleum Development in Trinidad — By WALLACE A. SAWDON	209
Natural Gasoline Plants in Argentina Employ Up-to-Date Processes — By THE STAFF OF Y.P.F.	210B
Intensified Operations in Existing Fields Have Characterized Argentina Oil Industry — By THE STAFF OF Y.P.F.	210E
Refineries of Argentina Include Well-Balanced Plants — By THE STAFF OF Y.P.F.	212
Geophysical Prospecting in South America — By W. R. RANSONE	218
Isolated Fields of Colombia Necessitate Adequate Maintenance Facilities — By H. W. PALKOWSKY *and* R. V. WELCH	218C

Copyright, 1939, by The Petroleum Engineer Publishing Company

The Course of Oil

By K. C. SCLATER

Progress In South America In this issue a special section is devoted to the oil industry of South America. Despite transportation, climatic, and other difficulties, oil operations on that continent are, on the whole, on a par with operations in the United States, so far as efficient practice is concerned. This has contributed to the success of operations and the modern trend developments in the oil industry has taken there.

T. N. E. Committee Testimony Testimony by witnesses before the Temporary National Economy Committee hearings in Washington on the oil industry, taken as a whole, gives a cross-section of the industry's problems.

Proration and conservation practices have come in for their share of discussion. One witness has suggested that each pool should be produced at its most effective, or optimum, rate and that equities, through balanced withdrawals, within each pool should be established. These two basic principles, it is contended, should be given a position of priority over those objectives that have often confused and distorted the administration of the conservation-proration concept.

Emphasizing the difficulties of reconciling reservoir conditions with other problems in a field, E. O. Thompson, member of the Texas Railroad Commission, told the Committee that the whole trouble lies in the fact that relationship between bottom-hole pressure and the note at the bank has never been established.

Under scrutiny by the Committee is the integration of oil companies; whether such integration fosters monopolistic tendencies. Defending integration in the oil industry, Dr. Robert E. Wilson, president of Pan-American Petroleum and Transport Company, told the Committee that greater stability in earnings resulted because these fluctuate more in the individual branches of the industry than in the industry as a whole; that less waste and lost motion occur by virtue of the fact that buying and selling several times between the well and the consumer are obviated; that in an integrated company there is greater confidence arising out of better insurance of supplies and market, and that this confidence is necessary to justify large expenditures for research and development and for the improvement of all facilities. It was also asserted that research could be made much more effective in a company that includes all branches of the industry. In an integrated company the availability of capital from overall reserves makes it possible to take advantage of opportunities in whatever branch of the industry they may arise.

One witness asserted that proration should be entirely on a basis of engineering principles and not on a basis in which supply is adjusted to demand. There is a growing conviction in the industry that perhaps were proration on this basis the overproduction menace would be removed or at least greatly mitigated.

Much of the testimony presented agrees with proration in principle but takes issue with its method of administration.

Whether or not proration has played as large a part in controlling crude prices as is contended by its opponents, it has been the greatest contributing factor in bringing about stability to the petroleum industry through wise conservation.

Employment Trends in Petroleum A report on technology, employment, and output per man in petroleum and natural-gas production, just published, states that "it is expected that over-all employment opportunities in oil and gas production probably will increase for at least the next decade and a half, although the manpower requirements of the different divisions of the industry will vary. The upward trend of employment at oil and gas wells—characteristic of developments until 1929—has been resumed and probably will continue for the next 10 or 15 years. The arresting of employment expansion in this segment of the industry during the depression years resulted largely from the drastic curtailment of drilling and its restriction to proved areas rather than from advancing technology. With growing consumption, the drilling operations, which require a large part of the labor force in oil and gas production, have been resumed on a more extensive scale in recent years. This development may be expected to continue, for it appears likely that demand will continue to increase.

"It is also likely that a larger labor force will be required at natural-gasoline extraction plants. A steadily growing demand for the lighter constituents of raw natural gasoline, which for many years were allowed to go to waste, plus the wider use of polymerization at natural-gasoline plants are factors tending toward an upward employment trend.

"Corresponding closely to the trend of crude-oil and natural-gas production, employment in refining reached an all-time high in 1937, when 83,183 wage earners were employed in the manufacture of petroleum products. On the basis of present anticipated developments, moreover, labor requirements at refineries probably will continue to increase for possibly the next 15 years."

This report is a National Research Project of the Work Projects Administration in coöperation with the U. S. Bureau of Mines.

Mississippi Produces Oil Mississippi is now an oil-producing state. Oil has been discovered there in commercial quantity after several years of prospecting activity costing many thousands of dollars, an expense that is sometimes overlooked when the cost of a barrel of oil is considered. Discovery of oil in this state increases potential oil reserves and adds a new area the development of which may presage the discovery of oil in states east of Mississippi.

STRENGTH · ELASTICITY · FLEXIBILITY · TOUGHNESS · DURABILITY

THE ACCIDENTAL FALLING... of an apple in an orchard started the chain of thought which led Sir Isaac Newton to propound his Law of Universal Gravity.

The Law of Leschen QUALITY

No accident, however, led to the establishment of quality as a requirement to be met by every Leschen product. Ever since Leschen Wire has been made there have been definite principles governing its manufacture... all based on the Leschen Law of *"Quality First."*

As a result you can be sure "HERCULES" (RED-STRAND) Wire Rope... true to its inheritance... will measure up to the highest standards of performance and meet the actual demands of the toughest jobs. Nothing is left to chance to give you long, safe and economical service.

You will get more out of "HERCULES" (RED-STRAND) Wire Rope because the Leschen Law of Quality demands we put the utmost into it.

"HERCULES" Rotary Lines are available in both Round Strand and Flattened Strand construction — either Standard or Preformed... We especially recommend the Preformed type of Wire Rope for Tubing Lines, Sucker Rod Lines and Winch Lines.

Domestic Distributors

AMERICAN SUPPLY COMPANY
Kilgore, Texas

CASEY & NEWTON
901 Century Bldg., Pittsburgh, Pa.

GUSTIN-BACON MANUFACTURING CO.
Kansas City

F. HAMILTON CO.
Bradford, Pennsylvania

HERCULES SUPPLY COMPANY
Fort Worth, Corpus Christi, Kilgore, Houston

HILLMAN KELLEY, INC.
2441 Hunter St., Los Angeles, Calif.

KIMBELL-BOSTIC SUPPLY CO., Inc.
Wichita Falls, Texas

THE B. LEVY ESTATE
Titusville, Pennsylvania

MURRAY-BROOKS HARDWARE CO., LTD.
Houma, Jennings, New Iberia, Villa Platte
Lake Charles, Louisiana

NORTH TEXAS HARDWARE CO., INC.
Vernon, Texas

NORVELL-WILDER SUPPLY COMPANY
Beaumont, Corpus Christi, Fort Worth
Houston, Monahans, Texas
Lake Charles, Louisiana

PARKERSBURG SUPPLY COMPANY
Parkersburg, W. Va.

UNION PIPE AND SUPPLY CO., INC.
Owensboro, Kentucky

UNITED PIPE AND SUPPLY CORP.
Charleston, W. Va.

UNITED SUPPLY & MFG. CO.
Tulsa, Oklahoma City, Stonewall
Houston, Odessa, Pampa, Denver City
Chase, Kans., Hutchinson, Kans.
Eunice, N. M.

WELL MACHINERY & SUPPLY CO., INC.
Fort Worth, Texas

WESTERN MACHINERY COMPANY
Salem, Ill., Evansville, Ind.

Export Distributor

CONTINENTAL EMSCO COMPANY, INC.
30 Rockefeller Plaza, New York, N. Y.
Branches: Buenos Aires, London, Ploesti

MADE ONLY BY

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U. S. A.

NEW YORK ... 90 West Street
CHICAGO ... 810 W. Washington Blvd.
DENVER ... 1554 Wazee Street

SAN FRANCISCO ... 520 Fourth Street
PORTLAND ... 914 N. W. 14th Avenue
SEATTLE ... 3410 First Avenue South

« « HIGHLIGHTS IN OILDOM » »

Price Advances Cheer Oil Producers

As a result of an increased demand for fuel oil, officials of the Humble Oil and Refining Company on October 2 announced an advance in crude oil prices in several Texas areas. The higher quotations were quickly met by other leading purchasers. On October 6, higher crude oil prices were announced for Pennsylvania. This bears out the prediction made in certain quarters for some time that crude oil prices were due for an advance.

The Humble's new Gulf Coast schedule begins at 86 cents a bbl. for oil of less than 20 gravity, and a 2-cent-a-degree increase ends with $1.28 a bbl. for 40 gravity and higher. This is a 1- to 7-cent-per-bbl. advance. A flat price of $1.10 a bbl. was posted for Hardin crude oil, a new district on the Gulf Coast. For Anahuac and Dickinson fields the new price ranges from 81 cents for less than 20 gravity to $1.23 a bbl. for 40 gravity and higher. This is also an advance of 1 to 7 cents a bbl. according to grade. In the Refugio field the price begins at 91 cents for less than 20 gravity and scales upward to $1.33 for 40 gravity and higher. At Mirando the price begins at 86 cents and advances to $1.28. In the Talco field the price has been advanced 10 cents a bbl. to a flat 65 cents.

Gulf, Sinclair Prairie, Atlantic, Shell, Republic, Magnolia, Stanolind, Cities Service, and others met the new postings.

The Sinclair Prairie Marketing Company also eliminated its gravity schedule for East Texas and substituted a flat price of $1.10 a bbl. In the North Texas area this company posted a 3-cent-per-bbl. advance, ranging from 79 cents to $1.03 for gravity less than 20 to 40 and higher.

In the East, The Tide Water-Associated Oil Company and the Joseph Seep Purchasing Agency put into effect a 25-cent-per-bbl. increase in four areas producing Pennsylvania grade crude oil. The advance resulted from a steady increase in demand for that grade of oil by lubricating oil refiners. The new prices follow, per bbl.: Bradford-Allegheny district, $2.25; National Transit Lines (Pennzoil), $2.18; Southwest Pennsylvania, $1.90, and Eureka, $1.84.

●

Request to Remove Referendum from California Ballot Is Denied

M. E. Atkinson, author of the California control bill, has failed in his attempt to defeat the referendum against his measure. He petitioned the State Supreme Court recently for a writ of mandate to prevent the referendum against the bill being placed on the ballot at the November 7 special election. He claimed that the petitions requesting the referendum contained many fraudulent signatures and asked that Secretary of State Jordan's certification of the petitions be withdrawn. The supreme court refused to issue the writ.

●

40-Acre Spacing Rule for New Mississippi Area

The Mississippi Oil and Gas Board has made effective a 40-acre spacing rule for the new Tinsley Dome field, Yazoo County, Mississippi. The rule specifies that tests be near the center of the 40-acre unit when possible, but if impracticable because of topography or for other reasons the test must not be more than 150 ft. from the center of the unit. The order also included rules for the setting of casing, safety precautions, etc.

New East Texas Proration Order Attacked

F. W. Fischer, independent operator of Tyler, Texas, has filed suit in the Federal District Court at Austin protesting the inclusion of the acreage factor in the formula in the Texas Railroad Commission's new East Texas proration order. This was the second attack on the order, which was devised to overcome the objections to the previous potential method. The new order provides a formula that includes the factors of potential, bottom-hole pressure, and acreage-ft. of sand.

Humble Oil and Refining Company, which with Rowan and Nichols, obtained an injunction against the prior order, also attacked the new order in a supplemental petition, predicating its complaint principally on a contention that the new order provides virtually a per-well basis.

Fischer complained that the acreage factor rendered the new order confiscatory. He asked an injunction restraining enforcement of the order and sought permission to produce as much from his wells as allowed those of similar potential.

●

Palestine Grants Oil-Prospecting Licenses

The Palestine Controller of Oil Mines has granted two oil-prospecting licenses to a company known as The Palestine Mining Syndicate, Ltd., according to a report by American Consul General George Wadsworth at Jerusalem. The licenses involve two areas, of 482 sq. km. and 498 sq. km. (186 sq. mi. and 192 sq. mi.), on the western shore of the Dead Sea.

●

Compulsory Dilution of Gasoline with Alcohol Abolished in Lithuania

The compulsory dilution of gasoline with dehydrated potato alcohol, which has been enforced in Lithuania since March 31, 1936, has been abolished. The diluted fuel, named "Motorin," had an alcoholic content of 35 percent. According to Lithuanian authorities, Motorin contained the following technical deficiencies: (1) Compared to gasoline, approximately 10 percent more Motorin is required for the same service; (2) Motorin produces sediments of salts detrimental to carburetors; (3) It is detrimental to painted parts; (4) Because of its hygroscopic nature, the alcohol draws water into the cylinders; (5) After burning, Motorin leaves more ash particles than gasoline, and (6) The ignition of Motorin is more difficult than that of gasoline.

●

Petroleum Production of Hungary Increasing

That Hungary will soon be able to satisfy its petroleum needs by local production is indicated in a report from the American Legation, Budapest, made public by the U. S. Department of Commerce.

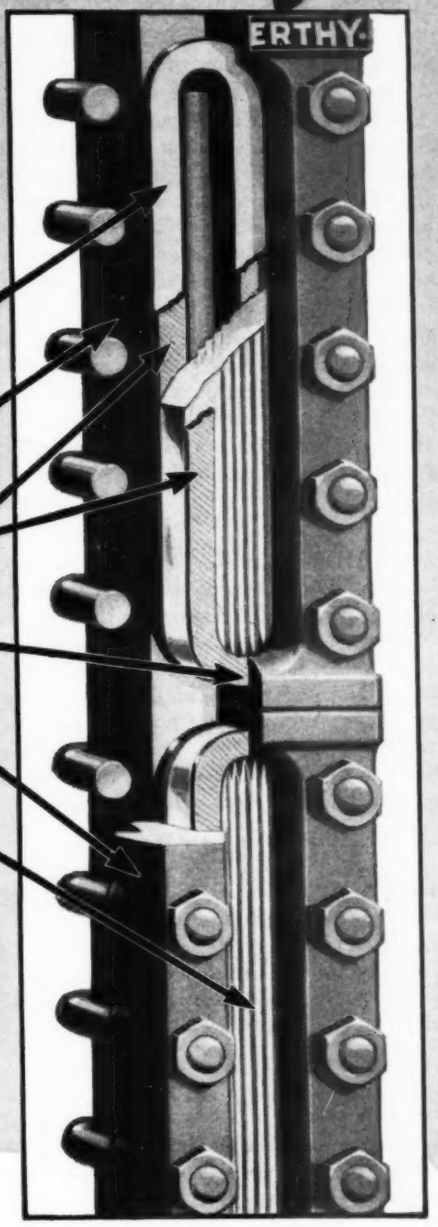
The output of Hungarian wells in the first half of the current year totaled 51,844 metric tons (388,500 bbl.) against only 12,764 metric tons (95,700 bbl.) in the corresponding period of 1938.

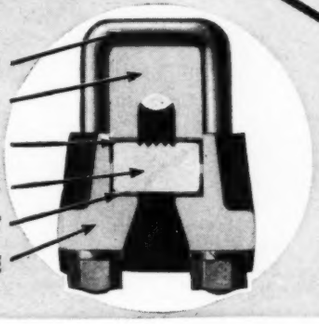
At the present time approximately two-thirds of Hungarian demand for petroleum is accounted for by the Government fields at Bukkszek and the fields of a private company at Lispe. Within a year, it is predicted, these two fields will be in a position to meet the entire Hungarian requirements.

Points of Superiority

PENBERTHY
DROP-FORGED STEEL *Reflex*
LIQUID LEVEL GAGES

- **GASKET GLAND** machined integral with liquid chamber fits snugly into glass chamber of frame preventing gasket blow-out.
- **LIQUID CHAMBER** alloy temperature resisting steel, heat treated, accurately machined and ground. Multiple section made in one piece.
- **GASKETS** are interchangeable and provide adequate and equal resilience on both sides of glass.
- **GLASS CHAMBER** in frame machined to contour of glass providing full metal backing for gaskets.
- **FRAME** drop-forged alloy temperature resisting steel with extra heavy beam at each end.
- **PYREX GLASS** has proved its greater strength and resistance to thermal shock and erosion.





PENBERTHY PRODUCTS

These Penberthy Drop-Forged Steel Reflex Liquid Level Gages are recommended for pressures up to 3000 lbs. per sq. in. at 100° F. and 1000 lbs. at 1000° F. They are provided in whatever lengths required and for various kinds of liquids. We shall be glad to quote upon your requirements.

Write for New Catalog No. 34-A

EMPTY SPACE SHOWS
WHITE
•
LIQUID SHOWS
BLACK

PENBERTHY INJECTOR COMPANY
Manufacturers of QUALITY PRODUCTS *Since 1886*
DETROIT, MICHIGAN • *Canadian Plant,* Windsor, Ont.

Major Pipe Line Activities

ONE of the most extensive pipe-line projects to be announced in recent weeks is that of the United Gas Pipe Line Company. That company has begun the laying of 175 miles of gas line, which includes an 18-in., 125-mile trunk line from Monroe, Louisiana, to Jackson, Mississippi, the other 50 miles consisting of gathering and connecting lines varying in diameter from 4 in. to 20 in.

The new line is being laid to supply additional gas to the United's Jackson-Pensacola-Mobile system, which serves areas in southeastern Louisiana, southern Mississippi, and southern Alabama and Florida. A connection will be made at Monroe with the line of the Arkansas Natural Gas Company. The latter will transport gas from the Sligo field in Louisiana and other fields in the Shreveport area and turn it into the United's line at Monroe.

Possibility of depletion of gas reserves in the Jackson area necessitates provision for a new gas supply. Water intrusion has caused the abandonment of many wells in the area, until only 40 wells of the original 144 are now on production, and 20 of these are producing some water with the gas. The Jackson field was discovered in 1930.

●

Work will begin about the middle of November on the construction of a 75-mile pipe line from the Cotton Valley field, Louisiana, to Okay, Arkansas, by the Louisiana-Nevada Transit Company. The announcement is made by T. R. Jones, president of T. R. Jones, Inc., Dallas, Texas. Jones, who is an official of the Louisiana-Nevada Transit Company, will be in charge of operating the new line. The line from Cotton Valley to Okay will be of 8-in. pipe and in addition an 11-mile branch will be laid of 6-in. pipe to Fulton and Hope, Arkansas. The line will serve industrial consumers.

●

According to reports an 80-mile pipe line extending from Seminole, Oklahoma, to Big Spring, Texas, is being planned by George Shryock of Fort Worth, Texas. The Cosden Refining Company will be the operator, it is stated, and its refinery at Big Spring would take approximately 5000 bbl. of crude daily from the line.

●

The new deep gas field on Chestnut Ridge, Fayette County, Pennsylvania, is to have another pipe-line outlet. L. J. Houze Convex Glass Company is laying a line from Point Marion, Pennsylvania, where it has a plant, to the J. H. Sorg farm in North Union Township. The line will be approximately 18 miles long and will be constructed of 4-in. pipe coupled. Completion of the project is announced for the last week in October. Sylvester Rich, Bradford, Pennsylvania, is the contractor.

●

A 2-in. pipe line has been laid from the Voth field, west Cooke County, Texas, to a loading rack at Muenster for movement of oil to the Tydal refinery at Gainesville. Original plans were to lay the line to Gainesville, but this is being delayed until greater production is available from the field.

The Lone Star Gas Company proposes to construct a 6-in. line from Buffalo, Texas, to College Station, Texas, to serve the towns of Madisonville, Centerville, Normangee, and Leona, company officials have announced. Construction of the line will depend upon the interest shown by prospective consumers in the towns mentioned.

The Lone Star Gas Company is the principal purchaser of gas from the Cayuga and Long Lake fields in Anderson County. A 20-in. line from the Long Lake field, through Cayuga, serves Dallas and other North Texas areas. Another line from Long Lake serves Central Texas towns.

●

The Sohio Corporation's 10-in. line from Salem to Stoy, Illinois, is being rushed to completion. It will extend from the Lake Centralia-Salem pool and will connect with the old Tide Water-Associated Pipe Line Company line that Sohio purchased recently as an outlet to eastern refineries. Connecting lines will be laid to other Illinois fields. Previously Sohio has moved its oil from fields in the eastern part of the state through the Wabash Pipe Line Company system to Noble, and to Martinsville through the Pure Oil Company line, at which point it connected with the line of the Illinois Pipe Line Company.

●

Sinclair Prairie Pipe Line Company has given the Rogers pool of northwestern Montague County, Texas, a pipe-line outlet by laying a 4-in. carrier to tie-in with its main line six miles west of Nocona. The Rogers pool was discovered soon after the first of the year and has been without an outlet. Heretofore, production has been trucked to independent refiners, and the Stanolind Oil and Gas Company, which has one producer in the field, has been trucking its oil to a pump station.

The pool has five producing wells, three of which are in the 4600-ft. sand and two in the 4300-ft. sand, both in the Strawn series.

●

The United Gas Pipe Line Company is preparing to lay an 18-in. pipe line to industrial centers along the west bank of the Mississippi River, according to an announcement. Gas supply will be from fields in LaFourche Parish, Louisiana, and from the LaFitte field, Jefferson Parish. More than a year ago United purchased 45 miles of right-of-way after making a survey of the area to be served.

●

Natural Gas Distributing Corporation, Nacogdoches, Texas, is laying a 31-mile, 6-in. gas line from the San Joaquin field to Garrison, Texas. O. B. Siler, vice-president and general manager, made the announcement. He also stated that the company planned eventually to extend the line to Lufkin, a distance of 21 miles, and that a 3-in. line will be laid from Tenaha to Center, Texas.

There may be UNCERTAINTY in the hole!

SETTING DOWN A RECORD STRING of 16-inch O.D. NATIONAL Seamless Casing. This 4,125-foot string was run complete ready for cementing, in 23½ hours. That's the kind of trouble-free performance you get with NATIONAL Seamless.

. . . but not in

NATIONAL SEAMLESS CASING

WILDCATS and proven fields are alike in one respect. Five, ten, or fifteen thousand feet below the surface, there's no sure way to predict just what conditions you are going to run into. But the chances are high that somewhere on the way down, your casing will have to stand up under some "tough going." If the casing is husky enough, you will never know how close you came to trouble. If not, you know the results.

That's why it never pays to take chances in selecting casing. And that's also why NATIONAL Tube, years ago, introduced Seamless Casing. Casing made by the seamless process has no weld—no long line of potential weakness. Each length of NATIONAL Seamless Casing is a perfectly formed steel cylinder, pierced from a solid billet of finest quality steel—no uncertainty about uniform wall strength.

NATIONAL Seamless Casing saves time and money in making up, too. It stabs easily and screws together smoothly, forming strong, tight, trouble-free joints. It's a premium casing at a popular price. Send for Bulletin No. 15.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Activities in the Oil Fields

NO. 1 J. C. Carr of Glenn McCarthy, a wildcat in the Anchor area of Brazoria County, Texas, has opened a new field in the lower Frio sand. Upon being completed, it flowed 85 bbl. of distillate in 12 hours through a 11/64-in. choke, the tubing pressure being 3100 lb. The total depth of the well is 10,530 ft. and production is through perforations at 10,460-67 ft.

●

No. 1-A State of Frank M. Farley et al, NE SW of section 16-20-32, western Lea County, New Mexico, has opened a new pool 11 miles from the nearest production. Drilled to a total depth of 2631 ft., the well filled 2500 ft. with oil in 6 hours. It appeared to lack sufficient gas to flow, however, and the operators, at a late report, were running 7-in. pipe to about 2600 ft. to test for completion. Production is from a limestone formation.

●

No. 1 Thompson of Hall-Briscoe, Inc., SW NE of section 28-13-1e, east of Jones, Oklahoma County, Oklahoma, has been successfully completed and opens a new Cleveland sand pool. The test was plugged-back to a depth of 4885 ft., and the casing perforated in the Cleveland sand, logged from 4795 to 4809 ft. When the hole was shot below the perforations, oil flowed over the derrick for 5 minutes. The hole filled and made several more head flows.

●

A new field apparently has been discovered near the old Earlsboro area, Pottawatomie County, Oklahoma. No. 1 Mickish of Simon D. Butcher, SW SW NW of section 36-10-4, made a head of oil and was shut-in for tankage. The well was drilled to a total depth of 4535 ft., but production is from a 25-ft. section of Hunton lime at a depth of 4263-88 ft. The casing was perforated at 4265-83 ft. by 107 shots to open the flow.

Nolan County, Texas, has been given its first producing well by No. 1 S. C. Tipton of Green & Owens and Metcalf & Hallinan. The discovery well is in the extreme northeast part of Nolan County, three miles southwest of Trent and seven miles southwest of the 13-year-old Noodle Creek field. Production is from the Strawn sand at a total depth of 5138 ft. The preliminary test indicated a probable production of 500 bbl. per day.

●

Despite meager reward thus far, exploratory drilling in the state of Missouri has continued with only slight abatement of activity during the summer months and probably will extend into the winter months. Most promising showing to date is Morrow and Rodgers No. 1 Cooley, SE NW of section 33-64-17, Adair County, in the northeast part of the state. At depths of 871 to 886 ft., a good showing of oil was tested; preparations are being made to acidize to obtain a more conclusive test.

●

An additional producing horizon in the prolific San Joaquin Valley, California, was discovered recently in the Fruitvale area by Meridian Petroleum Corporation in its No. 2 Fee, SW NE NW of section 23-29-27. A test of the formations between depths of 7596 and 7535 ft. resulted in the hole filling with fluid to within 90 ft. of the surface. Existing production in this field is obtained from an approximate depth of 3830 ft.

●

In the Indiana part of the Griffin pool, the Aux Vases zone has been found productive of oil, the first well in the state to produce from that formation. No. 1 Keck of Roberts Brothers, in NW NE NW of section 34-3s-14w, after being drilled to a total depth of 2799 ft., filled 750 ft. with oil on a 20-minute drill-stem test.

AVERAGE CRUDE PRICES

California		Louisana	
Kettleman Hills	$1.19-1.43	Rodessa	$1.05
Playa Del Rey	.80-1.16	Gulf Coast	.79-1.28
Coalinga	.70- .90	North Louisana	.73-1.05
Wilmington	.75-1.21	Illinois	.95-1.05
Montana	.90-1.10	Kentucky	.90-1.10
Wyoming	.35-1.30	Indiana	.95
Colorado	.90- .98	Ohio	
New Mexico	.53- .95	Lima	.90
Texas		Michigan	.74-.97½
North Central	.71-1.03	Pennsylvania	
Panhandle	.67- .96	Bradford	2.25
West Texas	.53- .95	Southwest	1.90
Gulf Coast	.86-1.28	Eureka	1.84
Darst Creek	.96	Buckeye	1.55
East Texas	1.10	Corning	1.02
Talco	.65	Canada	2.10-2.17
Kansas	.60-1.10		
Oklahoma	.60-1.10		
Arkansas	.73-1.05		

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in bbl. of 42 gal. each)

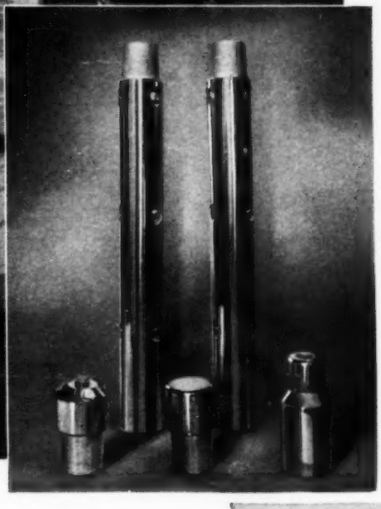
	[1]B. of M. Calculated Requirements (September)	Week Ended Sept. 30, 1939	Week Ended August 26, 1939	Week Ended Oct. 1, 1938
Oklahoma	429,300	[2]394,000	165,000	454,050
Kansas	166,300	[2]157,200	89,600	159,400
Panhandle Texas		68,350	18,200	68,250
North Texas		85,900	14,200	71,100
West Central Texas		30,800	6,600	28,750
West Texas		247,850	24,600	189,750
East Central Texas		92,800	4,450	89,150
East Texas		491,800	3,500	369,000
Southwest Texas		233,950	31,400	217,700
Coastal Texas		233,650	57,350	202,600
TOTAL TEXAS	1,408,300	1,485,100	160,300	1,236,300
North Louisiana		66,200	28,300	73,700
Coastal Louisiana		180,900	44,100	186,900
TOTAL LA.	255,700	247,100	72,400	260,600
Arkansas	50,700	65,850	29,800	57,750
Illinois	248,700	343,900	310,000	181,900
Eastern (not incl. Illinois)	101,300	103,850	96,000	
Michigan	55,000	68,350	65,300	50,050
Wyoming	70,700	66,250	65,900	53,500
Montana	16,300	16,450	15,950	13,450
Colorado	3,700	3,600	3,950	3,600
New Mexico	108,700	98,650	4,200	105,800
TOTAL EAST OF CALIF.	2,914,700	3,050,300	1,078,400	2,576,400
California	596,000	607,900	612,400	655,400
TOTAL U. S.	3,510,700	3,658,200	1,690,800	3,231,800

[1]These are Bureau of Mines' calculations of the requirements of domestic crude oil based upon certain premises outlined in its detailed forecast for the month of September. As requirements may be supplied either from stocks, or from new production, contemplated withdrawals from crude oil inventories must be deducted from the Bureau's estimated requirements to determine the amount of new crude to be produced.

[2]Oklahoma and Kansas figures are for week ended 7 A.M., September 27.

In the field of synthetic organic chemistry, The Dow Chemical Company, Dowell's parent organization, has made many important contributions to industry. Ethocel: most versatile of cellulose derivatives—for the manufacture of coating compositions, films and plastics. Styron: clear, colorless thermoplastic resin, a moulding material with unusual combinations of insulating properties, moisture resistance, dimensional stability and low temperature impact strength. Vinylidene Chloride: Dow's newest plastic is made from oil and salt, inert to all ordinary solvents, acids and alkalies, flows cold under pressure like a metal forging.

TRADE DOW MARK



Dowell's Latest Development

THE ACID JET GUN

Having inherited the same progressive spirit that makes its parent company famous in the field of synthetic organic chemistry, Dowell Incorporated is constantly developing products and services vital to the oil producing industry.

The Acid Jet Gun is Dowell's latest contribution. This tool permits streams of acid to be shot out horizontally or vertically against the walls or bottom of the well bore. The acid is projected through small diameter nozzles designed for effectively removing DOWMETAL* pipe, cement, limestone and calcareous deposits up to a distance of 15 inches from the nozzle.

Difficult problems confronting the industry will be solved by the Acid Jet Gun. This new tool is indispensable for (1) treating tight wells; (2) better control over acid; (3) cleaning out cavings from wells; (4) removing cement sheaths; (5) drilling out cement plugs; (6) deepening wells bottomed in limestone; (7) removing mud sheaths; (8) cleaning gyp from face of pay, screens and liners; (9) removing paraffin from face of pay; (10) perforating DOWMETAL pipe.

Dowell treating stations and sales offices are located in all principal oil producing areas. Operators interested in overcoming natural barriers to profitable production are invited to discuss their problems with Dowell engineers. Producers in ever-increasing numbers "look to Dowell" and get results.

*Trade Mark Reg. U. S. Pat. Off.

DOWELL INCORPORATED
Subsidiary of THE DOW CHEMICAL COMPANY
General Offices: TULSA, OKLAHOMA
Executive Offices: MIDLAND, MICHIGAN

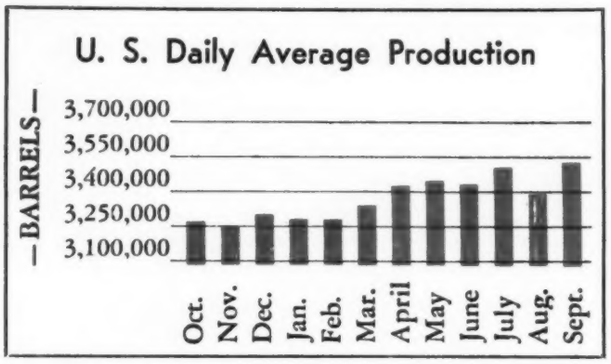
Oil men who attend the Golden Gate International Exposition are cordially invited to visit the Dowell exhibit in The Dow Chemical Company booth.

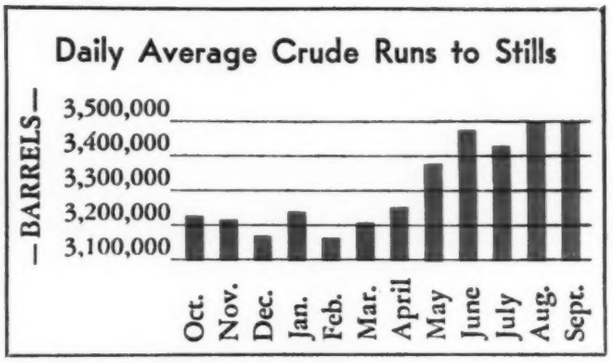
Look to

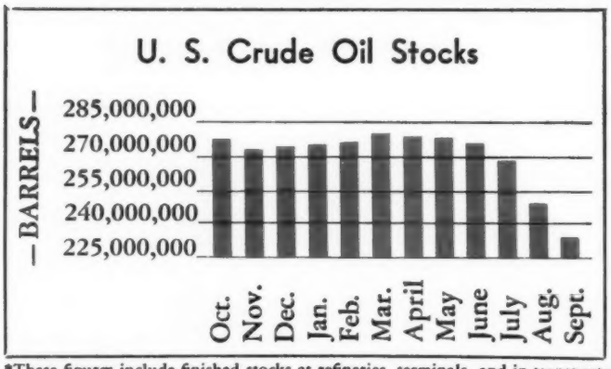
DOWELL

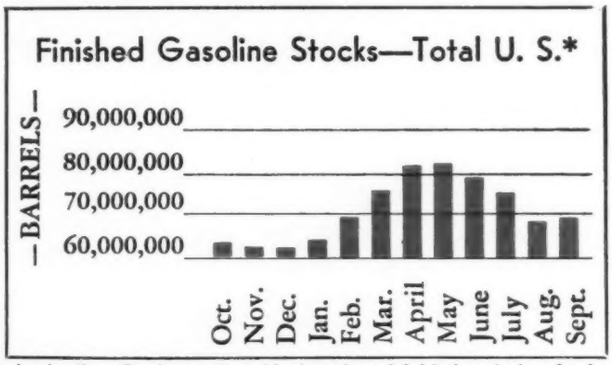
OIL AND GAS WELL CHEMICAL SERVICE

Petroleum Statistics and Field Activities









*These figures include finished stocks at refineries, terminals, and in transportation in pipe lines. Previous to June this chart showed finished stocks in refineries only. Above statistics by the American Petroleum Institute.

Summarized Operations in Active Fields for September, 1939

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	22	21	7	24	3500-3700	2	40	Rotary
Duval County	29	20	4	14	1554-2900	2	22	Rotary
Ector County	36	35	18	60	3675-4377	2 and 3	32-36	Rot.-Cab.
Panhandle	52	49	17	70	1700-3900	2	40	Rotary
Refugio County	8	7	2	7	4900-5900	2	38	Rotary
Nueces County	26	18	7	14	3922-5878	2 or 3	21-54	Rotary
Winkler County	8	8	2	7	2850-3450	2 and 3	30-38	Rot.-Cab.
K. M. A. Field	32	32	20	40	3730-3935	2	42-43	Rot.-Cab.
OKLAHOMA								
Oklahoma City	3	2	1	2	6450-6682	3	39	Rotary
Fitts Pool	21	18	3	17	1800-4488	2 or 3	38	Rotary
KANSAS								
Russell County	27	23	7	24	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	18	13	3	15	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	12	8	2	13	3290-3518	2	39-42	Rot.-Cab.
ILLINOIS								
Central Illinois	253	184	329	114	1425-4100	2	36-38	Rot.-Cab.
NEW MEXICO								
Lea County	43	43	8	44	3150-4030	3	30-34	Rot.-Cab.
CALIFORNIA								
Kettleman Hills	4	4	4	11	8300-8730	3 or 4	40	Rotary
Wilmington	16	16	4	16	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for September, 1939

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1938 (In Barrels)
	September	August	September	August	September	August	September	August	September	August	
Arkansas	18	28	17	24	22	16	17	15	38	36	18,211,617
California	96	97	83	90	105	123	115	89	208	197	249,918,001
Colorado	0	0	0	0	....	....	3	4	26	29	1,371,687
Illinois	253	374	185	310	....	....	298	**329	101	114	23,306,000
Indiana	54	15	32	11	....	....	12	7	59	62	965,900
Kansas	132	147	92	108	127	129	38	40	199	192	58,795,545
Kentucky	61	68	36	41	....	....	8	11	102	93	5,828,650
Louisiana	120	98	87	72	141	187	53	50	168	166	94,941,537
Michigan	148	127	119	83	163	140	21	18	151	141	19,140,966
Mississippi	4	1	1	0	....	....	2	2	5	8	Gas Prod.
Montana	15	15	14	12	....	....	3	4	35	27	4,858,458
New Mexico	64	53	57	48	49	64	15	16	124	135	39,902,263
New York	66*	77*	65*	71*	....	....	5	4	33	29	5,040,600
Ohio	114*	89*	83*	66*	....	....	40	46	166	156	3,292,100
Oklahoma	145	190	94	125	145	179	43	41	306	311	171,312,098
Pennsylvania	136*	192*	129*	184*	....	....	....	....	....	....	17,431,500
Texas	696	756	524	532	766	819	306	291	1057	997	473,304,662
West Virginia	60	63	53	50	....	....	24	23	126	124	3,700,375
Wyoming	14	17	14	15	....	....	4	5	72	71	19,005,638
Total	2196	2407	1685	1842	1518	1657	1007	995	2976	2888	1,206,827,597

*Includes water-intake and pressure wells.
**Includes 261 rigs standing and 68 rigging-up.

SAVE *from Start to Finish*

with the NOXIN *Surface Control*

GAS-LIFT SYSTEM

Producing an oil well after it has ceased flowing has always been an expensive operation. BUT NOW the Nixon Surface Control Gas-Lift System has revolutionized production to where it is profitable to produce extremely small volume wells.

The original installation is made to produce the well from start to finish. With about 800 Nixon units now installed there are many wells producing as little as 3 to 10 barrels a day, profitably... whereas with other types of lifting equipment, production would be too costly to operate.

The Nixon Gas-Lift System costs LESS than standard pumping equipment... LESS to install... LESS to move on location... LESS to operate... LESS to maintain.

Have a Nixon Gas-Lift engineer tell you how these savings can be made on your production. Write your nearest Wilson Supply Company store or sales office.

WILSON SUPPLY CO.

1412 MAURY ST. — **HOUSTON, TEXAS**

OIL & GAS WELL SUPPLIES

Complete line of
FISHING TOOLS & SERVICE

EXCLUSIVE GULF COAST DISTRIBUTORS FOR: Wilson-Snyder Pumps; American Cable Tru-Lay Pre-formed Wire Rope; Kewanee Boilers; Sievers Reamers; Drift Meter, Jr.; Gray Swivel; Nixon Surface Control Gas Lift; Nixon True-Taper Slip and Spider; Bowen Pack-Off and Releasing Drill Pipe Overshot; Douglas Weight Indicator.

BRANCH STORES:
TEXAS: Gladewater; Barbers Hill; Bay City; Monahans; Alice; Victoria; Corpus Christi; Benavides; Arkansas City.
LOUISIANA: Rodessa; Lake Charles; New Iberia; Gretna; Shreveport.
ARKANSAS: Magnolia.
SALES OFFICES: Tulsa, Oklahoma; Dallas, Texas.

Activities in Refining

Percent Refining Capacity Operated

Western Division, 73.4 Percent **Central Division, 83.5 Percent** **Eastern Division, 92.7 Percent**

A 1000-bbl. refinery is being constructed at Alamosa, Colorado, by the William E. Hughes estate. The Gramps Oil and Refining Company has been newly-organized by the estate for the express purpose of operating the new plant. The refinery was designed and is being erected by Frank Shelly of the Shelly Oil Company, Bay City, Texas.

The refinery, to include a cracking unit, will process crude oil produced in the Gramps pool, Archuleta County, southern Colorado. In addition to the refining units, approximately 20,000 bbl. of storage capacity has been erected and additional tankage may be added soon.

●

An additional cracking still and other improvements will be added by Republic Oil Refining Company in its refinery at Texas City, Texas. Present capacity of the plant is 5000 bbl. daily. Expenditures will be between $750,000 and $1,000,000.

●

The equipment comprising the refinery operated by Solvex Refinery, Inc., at Gladewater, Texas, and recently purchased by the Pana Refining Company, an Illinois corporation, has been moved to Pana, Illinois. The refinery, built around a Dubbs cracking unit, has been completely reconditioned under the supervision of engineers of the Universal Oil Products Company, Chicago.

The new refinery will process 3000 bbl. of crude oil per day, obtained through a 25-mile pipe line from the Louden field, Illinois.

●

Sinclair-Prairie Oil Company is building an absorption-type gasoline plant in the East White Point field, San Patricio County, Texas. The plant will have a maximum capacity of 7,500,000 cu. ft. per day. An agreement has been made with operators of the 100 wells in the field whereby the gas produced from the wells will be made available to the plant for processing.

L. M. Lockhart, San Antonio, Texas, has awarded the contract for constructing a condensate-recovery and recycling plant in the Agua Dulce field, Nueces County, Texas, to Petroleum Engineering, Inc., Tulsa, Oklahoma. The plant is designed to process 25,000,000 cu. ft. of gas per day, recovering approximately 25,000 gal. of condensate.

This plant will be the fourth of its type to be built in the field. Lockhart has several condensate wells in the northern part of the field. He proposes to drill 6 additional wells to a depth of about 800 ft., and then consolidate the group, using at least one well as a means of returning gas underground.

●

Seven 600-hp. Clark angle-type compressors will be installed in the Shell Oil Company's gasoline plant at Seagraves, Texas.

●

Oil activity in Mississippi has stimulated plans for a refinery in the state. It has been announced that a 2000-bbl. refinery will be built at Yazoo City, Mississippi, by the Yazoo Refinery Company, Inc.

●

Said to be the first coöperative refinery built in the United States, a 3000-bbl. plant is being constructed at Phillipsburg, Kansas, by the Consumers Coöperative Association of North Kansas City, Missouri. A pipe line to tap fields in western Kansas now without an outlet has been surveyed but construction has not yet started.

●

A natural gasoline plant is being built by the Mid-Continent Petroleum Corporation in the Ramsey pool, nine miles southwest of Stillwater, Payne County, Oklahoma. Output of the plant is expected to be approximately 15,000 gal. of gasoline and between 8,000 and 10,000 gal. of butane per day. Estimated cost of the plant is approximately $150,000.

Crude Runs to Stills, Gasoline, Gas and Fuel Oil Stocks
Week Ended September 30, 1939

A.P.I. Figures
(Figures in thousands of bbl. of 42 gal. each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks	Total Gas and Fuel Oil Stocks
East Coast	100.0	561	91.2	18,545	22,821
Appalachian	85.9	122	95.3	2,519	718
Ind., Ill., Ky.	90.2	507	91.4	10,931	7,709
Okla., Kans., Mo.	81.6	271	79.2	5,838	4,638
Inland Texas	50.3	116	73.0	1,505	2,305
Texas Gulf	90.0	854	89.9	9,116	13,929
La. Gulf	97.6	126	78.8	2,113	3,358
No. La. & Ark.	55.0	53	96.4	355	825
Rocky Mt.	54.2	47	73.4	1,062	650
California	90.0	546	73.3	14,224	93,309
Reported	86.2	3,203	84.9	66,208	150,262
Estimated Unreported	.....	357	.....	4,960	3,265
*EST'D TOTAL U. S. SEPT. 30, '39	.....	3,560	.....	71,168	153,527
*EST'D TOTAL U. S. SEPT. 23, '39	.....	3,570	.....	71,020	153,141
U. S. B. of M. *SEPT. 30, 1938	.....	**3,233	.....	69,086	151,226

*Estimated Bureau of Mines' basis.
**September, 1938, daily average.

E. Engin. Lib.
Gift of Prof. T. G. Brown
4-17-41

P 422.912.5

THE Petroleum Engineer

OCTOBER, 1939

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Preliminary Design of Drilling Barge for Deep-Water Prospecting

Proposed design involving telescopic legs, if successful, may permit future development of offshore areas in depths as great as 50 ft.

Part 1

By ROYDEN H. ROGERS

Marine Engineer, Marine Department, Standard Oil Company of New Jersey

IN recent years the desire to bolster the known petroleum reserves of the world has caused the oil industry to expend considerable time, money, and energy in searching for new sources of supply. One of the most interesting phases of exploration work at the present time deals with the possibility that large untapped reserves may exist under the various inland and coastal waterways of the world. In the Western Hemisphere exploration of this character has resulted in underwater drilling along the Texas coast in the region of Galveston Bay, Matagorda and Padre Islands, and along the California, Louisiana, and Venezuelan coasts. The last three areas mentioned include producing fields and have large numbers of wells in operation.

At the present time underwater drilling is done by equipment mounted on submersible barges or on platforms or decks constructed on pile foundations. Each method of drilling has its advantages and disadvantages. The system of drilling from a submersible barge affords a compact, self-contained, mobile drilling unit mounted on a fixed working platform. This cuts down drilling costs, for after a well is brought in it is not necessary to dismantle the rig before moving on to a new location. A disadvantage is the fact that the depth of water in which it can work is limited, due to the inherent dismensional characteristics of a barge. In addition, the large plane bottom surface of a barge makes it necessary to work on a level bottom. This is not always possible unless leveling work is carried out, increasing the drilling cost.

Drilling from a platform laid on a

ROYDEN H. ROGERS

is a graduate of the University of Michigan, Department of Naval Architecture and Marine Engineering, class of 1932— His experience has been principally in ship design with leading ship builders on the Atlantic Coast—Since March, 1938, Rogers has been connected with the Marine Department, Construction and Repair Division, Standard Oil Company of New Jersey.

pile foundation affords an access to sites in water of depth limited only by the practicable length of the piles and the capacity of the pile-driving machinery available. An uneven bottom presents no added expense, as the size of the pile compensates for any roughness. After drilling is completed, however, heavy expense is entailed in removing the drilling equipment and in dismantling that portion of the foundation not needed when the well is in production.

It would appear, then, that the ideal drilling rig should combine the advantageous characteristics of both the submersible barge and the pile-founded platform as a compact, self-contained unit on a mobile platform having a capacity for deepwater drilling.

When designing a floating drilling rig, the design engineer should at least endeavor to fulfill the following list of conditions if the finished craft is to render satisfactory, economical service. The rig should:

1. Be capable of drilling in shallow or deep water,

2. Offer an adequate working platform having all drilling equipment arranged for efficient drilling,

3. Be mobile (either self-propelled or not, depending on location and available tug facilities),

4. Be able to ride out reasonably bad weather without danger to equipment or personnel,

5. Have ample storage facilities; that is, it should be virtually self sustaining insofar as supplies of operating stores, drill pipe, casing, etc., are concerned,

6. Have adequate transverse stability,

7. Have adequate longitudinal stability,

8. Offer a dry working platform in bad weather (protected from both rain and sea), and

9. Be capable of being removed easily after completion of the well.

A floating drilling rig that can drill in water varying from 9 to 50 ft. in depth and that will fulfill the tentative design objectives as outlined is shown in Fig. 1.

General Description of Equipment

The buoyancy of this drilling rig is supplied primarily by two pontoons tied together in catamaran style by a series of five heavy transverse girders. These transverse girders are firmly bracketed into the supporting columns of the craft so that the steel structure is virtually a structural bent. Longitudinal strength is derived from the two pontoons, the longitudinal girders between the columns being designed primarily as supports for the drilling equipment, derrick, and storage rack.

When the equipment listed in Table 3 is on board, this craft, ready to move to a drilling site, has a draft of 9 ft. 10 in. If necessary, the weight of the drilling pipe and casing may be eliminated to reduce the draft to approximately 8 ft. 8 in.

The length and beam of 168 and 57 ft., respectively, were set as maxima to permit transit through canals, inland waterways, bayous, etc. It would be advantageous perhaps to reduce the beam further but the high center of gravity of the derrick and equipment requires a substantial beam to provide adequate transverse stability.

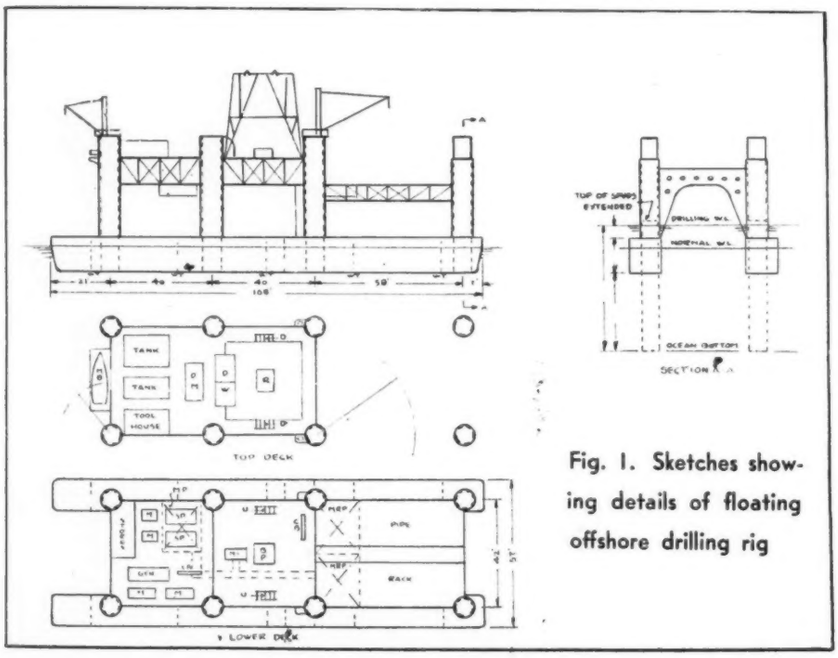


Fig. 1. Sketches showing details of floating offshore drilling rig

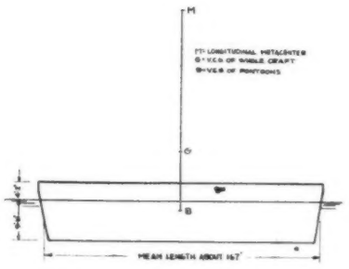


Fig. 2

The layout of the drilling machinery is shown in Fig. 1. There are two working levels or platforms. The top deck corresponds to the derrick floor. The equipment on this deck includes two cranes used to manipulate the workboat and to unload supplies. To obtain gravity feed, the various fuel and water tanks are also located on this deck. On the lower deck additional drilling machinery is situated. Suspended under this deck, the mud and mud reserve pits are interconnected by a mud "ditch".

A control panel for operating the ballast pumps is situated on the lower deck amidship on the port side. This is also the control point for the spud locking devices, the type of control depending on whether the locking devices are operated mechanically, by hydraulic means, or by compressed air. A combination mechanical and hydraulic device appears to be the best design at present. Individual ballast pumps, controlled from the central panel, are mounted above each spud.

The pontoon ballast pumps are situated in watertight compartments in each pontoon. The suction lines from the various ballast compartments of each pontoon are manifolded into a single overboard discharge. In turn, the manifolds in each pontoon are interconnected by a crossover at Bent No. 2 so that under emergency conditions one pump may accommodate all ballast compartments. Entry to the pump room is afforded by means of a watertight manhole in the access trunk extending to the lower deck.

The craft, as designed, is non-propelled. This, of course, is more or less satisfactory when there is adequate towing service available. If this is lacking, it is entirely possible to adopt a twin-screw method of propelling the craft. When propelling equipment is desired, an electric drive installation is the logical choice because of the large

generator capacity required for drilling purposes, but idle during a move.

When drilling in deep water the spuds are lowered by filling them with water and are then locked into position. For example, if drilling in 50 ft. of water, the spuds are locked into the proper position in relation to the pontoons when they are as shown in Fig. 1 (drilling position). The detailed method of setting the craft in the drilling position will be discussed later.

A Brief Description of the Design Methods

1. Weights. Table 1 lists the weights of the drilling equipment on board when in the floating position. The vertical and longitudinal center of gravity is also given for all equipment on the respective decks.

Table 2 gives the weight of the steel structure, excluding the pontoons, and the vertical and longitudinal center of gravity. The pontoons as shown in Fig. 1 are 168 ft. by 12 ft. by 14 ft. deep. These pontoons are designed according to the American Bureau of Shipping requirements for deep tanks having a head 10 ft. above the top of the pontoon. When built, the pontoons weigh 268,700 lb. or approximately 120 long* tons each. The center of gravity of the pontoons is 7.02 ft. above the bottom and directly above the midpoint of the overall length of 168 ft.

2. Displacement. A check of the craft's displacement may be made by using the data shown in Tables 1 and 2, and recapitulated in Table 3.

This check is as follows:

Total weight of craft (see Table 3), 1118 long tons. Depth to which pontoon must be immersed to displace 1118 tons =

$$d = \frac{\text{Displacement} \times 35}{2\,(l)\,(b)} = \frac{1118 \times 35}{2\,(168 - 1) \times 12} = 9.8 \text{ ft.}$$

in which

35 = volume in cu. ft. per long ton of salt water

$l = 168 - 1 = 167$ ft. = mean length of pontoon

$b = 12$ ft. = beam or width of pontoon

3. Trim. Table 4, which shows among other things, the horizontal distance to the center of gravity may be used to check the location of the horizontal distance to the center of gravity relative to the longitudinal center of buoyancy (LCB) of the pontoons. In order that the craft may float on an even keel, it is essential that the two centers coincide. Table 4 shows that the center of gravity is 84.1 ft. from the forward edge of the pontoon. Because the pontoon is symmetrical in shape fore and aft, the LCB will be at the midlength. The pontoon being 168 ft. long, the LCB is 84 ft. The difference of 0.1 ft. being negligible, the craft will float on an even keel.

4. Longitudinal Stability. The subject of longitudinal stability is very important in a craft of this type because it is possible that numerous heavy machinery and casing loads will be shifted on board during its operating life. These unknown factors make it essential that the craft have an adequate stability reserve. The calculations involved are based on the symbols shown in Fig. 2.

This factor of stability, which we shall express as the moment to change trim one inch, is calculated as follows: Moment to change trim 1 in. =

$$\frac{\text{Displacement} \times GM}{12 \times L}$$

Moment of inertia of water plane = $\frac{2\,bl^3}{12} = \frac{2 \times 12 \times 167^3}{12} =$ 9,315,000 ft.$^4 = I$

TABLE 1

Equipment and Material for Drilling 10,000-Ft. Offshore Well

PART 1

Equipment on Lower Deck (20 Ft. Above Top of Pontoons)

Name of equipment	Weight, lb.	*Height of center of gravity above lower deck, ft.	Vertical moment in ft-lb.	*Horizontal distance of center of gravity from centerline of forward column, ft.	Horizontal moment in ft-lb.
Prime movers, generators, engine-generator drive, foundation, starting unit, etc.	81,720		237,720		9,914,080
Slush pump, washdown pumps, motors, drive and controls	96,000		365,445		10,833,777
Motor generator, pump, and mud storage houses	11,360		56,800		1,378,560
Derrick substructure and reinforcements	29,150		145,750		2,283,700
Mud store, mud mixer, and mud screen	27,200		105,400		3,573,000
Steel pipe rack, walk and apron	16,000		71,500		1,228,000
Blowout preventer and master gate	18,900		91,500		1,474,200
Mud pit, reserve pit, mud return ditch, hydro tank and mud pit contents	333,500		—632,000		25,516,000
Equipment totals	613,830	.72	442,115	91.56	56,201,317
Long tons	274				

*Note—Height of center of gravity above baseline = height as shown plus 34 ft.
Horizontal distance of center of gravity from forward end of pontoon = horizontal distance as shown plus 7 ft.

PART 2

Equipment on Top Deck (30 Ft. Above Top of Pontoons)

Name of equipment	Weight, lb.	*Height of center of gravity above lower deck, ft.	Vertical moment in ft-lb.	*Horizontal distance of center of gravity from centerline of forward column, ft.	Horizontal moment in ft-lb.
Steel derrick, guy wires, housing and flooring	64,830		2,761,760		5,056,740
Drawworks, rotary, 2-200 hp. drilling motors and reducing gear	84,000		306,302		7,677,267
Crown and traveling blocks, swivel, casing hook, kelly, breakout tongs	42,315		1,344,570		3,240,342
Drill, coring and cat lines, coring reel, drill collar and reamer, etc.	34,097		1,016,972		2,659,566
Tool house, water tank, rotary hoses, engine cooling tower, etc.	98,672		512,344		11,416,548
Miscellaneous pipe and fittings, 2 cranes, boat, pontoon pumps	115,000		625,000		9,435,000
Drill pipe, 4½-in. diam. (Craft floating-pipe on rack)	162,500	—7.50	—1,218,750	29.00	4,712,500
Equipment totals (drill pipe on rack)	601,414	8.89	5,348,198	73.49	44,197,963
Long tons	268				
Equipment on top deck less drill pipe	438,914	14.90	6,539,820	89.90	39,458,370
Drill pipe, 4½-in. diam. (Craft floating-drill pipe in derrick)	162,500	47.00	7,637,500	78.00	12,675,000
Alternate equipment totals (drill pipe in derrick)	601,414	23.57	14,177,320	86.68	52,133,370

*Note—Height of center of gravity above baseline = height as shown plus 44 ft.
Horizontal distance corrected as in Part 1.

*All weights given in tons are calculated as long tons of 2240 lb. throughout.

TABLE 2
Weight of Floating Structure (Excluding Pontoons)

Item	Weight, lb.	Height of center of gravity above base of pontoon, ft.	Vertical moment in ft-lb.	*Horizontal distance to gravity from centerline of forward column, ft.	Horizontal moment in ft-lb.
2 spuds at 31700	63,400	26.0	1,648,400	0	0
" "	63,400	26.0	1,648,400	58	3,677,200
" "	63,400	26.0	1,648,400	98	6,213,200
" "	63,400	26.0	1,648,400	138	8,749,200
2 columns at 18000	36,000	29.0	1,044,000	0	0
" "	36,000	29.0	1,044,000	58	2,088,000
" "	36,000	29.0	1,044,000	98	3,528,000
" "	36,000	29.0	1,044,000	138	4,968,000
Mud pit supports	7,000	31.0	217,000	48	336,000
" " "	3,000	31.0	93,000	110	330,000
Athwartship trusses or beuts	5,000	25.0	125,000	0	0
" " "	5,000	25.0	125,000	58	290,000
" " "	5,000	25.0	125,000	98	490,000
" " "	5,000	25.0	125,000	138	690,000
Pipe rack at 100 lb./ft.	10,000	31.0	310,000	54	540,000
" " "	3,200	31.0	99,200	0	0
Machinery girders at 225 lb./ft	50,400	39.0	1,965,600	92	4,636,800
Floor girders at 25 lb./ft.	56,250	38.5	2,165,625	92	5,175,000
Flooring at 7 lb./sq. ft.	42,000	39.25	1,648,500	92	3,864,000
Miscellaneous fittings	10,000	18.0	180,000	83	830,000
Pumping and piping equipment	30,000	23.0	690,000	83	2,490,000
Structural totals	629,450	29.61	18,638,525	77.68	48,895,400
Tons	281				

*Note—Horizontal distance of center of gravity from forward end of pontoon = horizontal distance as shown plus 7 ft.

TABLE 3
Recapitulation of Offshore Drilling Rig Weights (Craft in Floating Position)

Item	Pounds	Tons
Equipment weight		
Equipment on lower deck (20 ft. above top of pontoons)	613,830	274
" " " " (30 " " " " " ")	438,914	196
Drill pipe, 4½-in. diam.	162,500	73
(The following casing is allowed on board in the floating position)		
Casing 300 ft.—18⅝-in. diam.	23,400	10
" 1450 ft.—13⅜-in. diam.	98,600	44
Equipment totals	1,337,244	597
Structural weight		
Structure (excluding pontoons)	629,450	281
Pontoons (2 at 268700 lb.)	537,400	240
Structural totals	1,166,850	521
Total weight of craft		1118

TABLE 4
Craft Floating Free—Draft 9 Ft. 10 In.—Drill Pipe and 1750 Ft. of Casing on Pipe Rack

Item	Weight in tons	Height of center of gravity above baseline, ft.	Moment in ft-tons.	Horizontal distance to center of gravity from forward end of pontoon	Moment in ft-tons
Equipment on lower deck	274	34.72	9,510	98.56	27,000
" on top deck	196	52.89	14,230	80.49	21,650
Drill pipe on pipe rack	73				
Casing on pipe rack	54	34.50	1,865	36.00	1,940
Structural weight (excluding pontoons)	281	29.61	8,320	84.68	23,800
Pontoons	240	7.02	1,685	84.00	20,160
Totals	1118	31.85	35,610	84.57	94,550

TABLE 5
Craft Floating Free—Draft 9 Ft. 10 In.—Drill Pipe in Derrick and 1750 Ft. of Casing on Pipe Rack

Item	Weight in tons	Height of center of gravity above baseline, ft.	Moment in ft-tons	Horizontal distance to center of gravity from forward end of pontoon	Moment in ft-tons
Equipment on lower deck	274	34.72	9,510	98.56	27,000
" on top deck	196	58.90	11,540	96.90	18,990
Drill pipe in derrick	73	91.00	6,640	85.00	6,210
Casing on pipe rack	54	34.50	1,865	36.00	1,940
Structural weight (excluding pontoons)	281	29.61	8,320	84.68	23,800
Pontoons	240	7.02	1,680	84.00	20,160
Totals	1118	35.38	39,555	87.75	98,100

Transverse metacenter = BM = $\frac{I}{35 \times \text{Disp.}} = \frac{9{,}315{,}000}{35 \times 1118} =$ 238.05 ft.

Based on the conditions of Table 4, the moment to change trim 1 in. = $\frac{\text{Disp.} \times GM}{12\,l} = \frac{1118 \times 211.48}{12 \times 167} =$ 117.98 ft-tons.

Note:

V.C.G. = 31.7 ft. (see Table 4)

GM = 238.26 + 4.92 — 31.7 = 211.48 ft.

Based on the conditions of Table 5, the moment to change trim 1 in. = $\frac{1118 \times 207.78}{12 \times 167} = 115.92$ ft-tons.

Note:

V.C.G. = 35.4 (see Table 5)

GM = 238.26 + 4.92 — 35.4 = 207.78 ft.

The term trim means the difference between the bow and stern drafts. The craft being discussed has a freeboard of 50 in. that allows a trim of 100 in. before the deck edge is under water. The moment necessary, therefore, to put the deck edge under must be 117.98 × 100 = 11,798 ft. tons under the operating conditions described in Table 4. A movable weight of 140 long tons already on board (represented by the weight of drill-pipe, casing, and 13 tons of other equipment) if moved from the longitudinal center of the craft to the extreme end would just about put the deck edge under water, viz. 140 × 84 = 11,760 ft-tons. Thus, it would appear that the craft has adequate longitudinal stability.

5. Transverse Stability. The moment to resist overturning in a transverse direction is of great importance in a craft of this type. The fact that numerous heavy weights are placed as much as 100 ft. above the baseline of the craft necessitates a close study of their effect on the heeling properties of the floating structure. The moment necessary to resist overturning at various angles of heel we shall call the righting moment.

EDITOR'S NOTE: In Part 2 of this article, which will appear in an early issue, the discussion of transverse stability will be continued. Discussions and calculations of clearance when shifting drilling positions, of ballast to overcome buoyancy, and of preparations for drilling will conclude the presentation of this interesting article. Additional tables and sketches will appear in support of the further calculations.

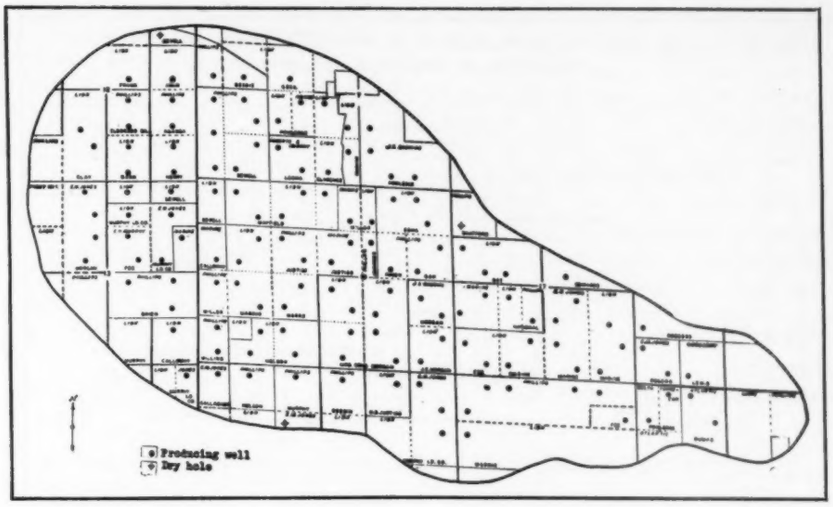


Fig. 1. Ownership in the Jones pool, Schuler field, Arkansas, is divided among 12 operators

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Data on Gas-Driven Pool Discloses Characteristics Differing From Water-Driven Reservoirs

Complete production data since discovery of gas-driven pool in Schuler field, Arkansas, will be a valuable case-record for the petroleum industry

By ALEC M. CROWELL
Director-Engineer, Arkansas Oil and Gas Commission

WHEN considering the underground behavior of oil and gas, and the factors that control such behavior, we have grown accustomed to thinking in terms of water-driven or hydraulically-controlled deposits. We have done so because primary production is predominantly in this class.

It is recognized that in a normal gas-drive reservoir, the edge or flank leases enjoy a natural or inherent ability to yield high ultimate recoveries.

The high ultimate productive ability of a flank or edge well in a gas-drive reservoir is due to the fact that the source of energy, being remote, delivers to the core of the well the desired oil without the complication of large volumes of gas.

The energy in a water-drive reservoir is expended in a reverse direction, i.e., up structure; the edge or flank leases are therefore unfavorably placed from a standpoint of ultimate recovery and low operating cost.

Because of this fundamental difference, favorable or unfavorable structural position has begun to be spoken of as a natural or inherent equity, the equity value varying with reservoir type.

In a gas-drive reservoir, as the pressure declines the gas comes out of solution and the oil becomes increasingly inert until eventually it does not contain enough energy to provide for its own movement to the well bore. In addition to the continued degradation of energy by removal of gas from solution in the oil, the free gas acts to clog the sand pores and thus hamper the progress of the moving oil.

It is obvious, then, that pressure in the reservoir is of paramount importance and must be guarded and zealously used, in the absence of means to maintain the reservoir pressure.

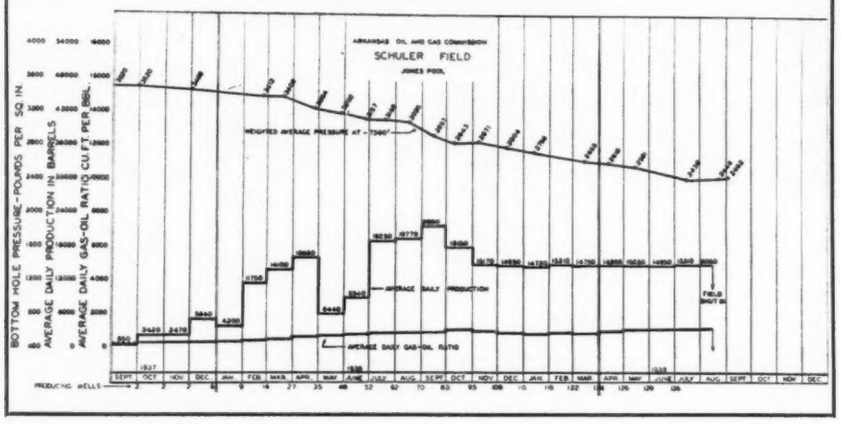
The proration pattern under which the pool discussed in this article is now operating is predicated upon efficient depletion and equitable withdrawal for the pool as a whole.

This article is a progressive report and deals only with the early history of the pool and its exploitation to date. Future operating practice, regulatory policy, and repressuring or pressure maintenance possibilities are too problematical to warrant discussion.

ALEC M. CROWELL

began his present connection with the Arkansas Oil and Gas Commission in April, 1938, when he was employed to work jointly with the old Board of Conservation and the oil operators' committee—He served as technical advisor in the drafting of the present state conservation statute and was retained by the Commission created by that act to administer the law after its passage in March, 1939—Immediately prior to that time he was successively chief gas engineer and supervisor of field engineering and research for a period of five years (1933-1938) for the Oil and Gas Division of the Texas Railroad Commission having headquarters at Austin—His first connection with the industry was as junior engineer with the Empire Oil and Refining Company in 1926 and was employed as engineer on that company's properties in Kansas, Oklahoma, New Mexico, and Texas until late in 1930—Leaving the Empire, he was employed as production engineer with the Del Rey Oil Company of California, working in the Los Angeles Basin.

Fig. 2. In this chart of production data, double vertical lines represent transitions in proration rulings


ARKANSAS OIL AND GAS COMMISSION
SCHULER FIELD
JONES POOL
BOTTOM HOLE PRESSURE - POUNDS PER SQ IN
AVERAGE DAILY PRODUCTION IN BARRELS
AVERAGE DAILY GAS-OIL RATIO CU FT PER BBL
WEIGHTED AVERAGE PRESSURE AT -7300'
AVERAGE DAILY PRODUCTION
AVERAGE DAILY GAS-OIL RATIO
FIELD SHUT IN
PRODUCING WELLS

The Jones Pool

The Schuler field, of which the Jones pool is one of the three productive horizons, is situated 18 miles west of El Dorado, covering nine sections of land centering around section 18-18s-17w, Union County, Arkansas. The structure of the field is an anticline and production is obtained from the Morgan Sand, 5550 to 5990 ft.; the Jones Sand, 7500 to 7600 ft., and the Reynolds Lime, 7600 to 7675 ft. The Morgan and Jones sands are assumed to be in the Cotton Valley formation of Mesozoic Age. The Reynolds Lime is in the upper part of the Smackover Lime and is believed to be of Mesozoic Age, although it is sometimes referred to as being of Permian Age.

The Jones pool is one of the relatively few oil and gas reservoirs from which the natural production is being obtained through volumetric control—and upon which comprehensive data have been gathered throughout the productive life. The pool is still in its primary development, all wells flowing with the exception of two, these being completed upon the structure in such a position as to require almost immediate pumping.

Very accurate information on progressive gas-oil ratio, bottom-hole pressure, and producing rates has been kept by the Arkansas Oil and Gas Commission. This information is available both from the individual wells and areally weighted for the pool as a whole. In addition, there is a wealth of data on productivity tests, solubility-shrinkage information, bottom-hole sample analyses, etc.

The operators in the pool have so developed their properties that an unusual number of the wells have been cored through the formation and these cores analyzed. Practically all wells were electrically logged, and producing strings were set completely through the productive formation and gun-perforated low in the oil-saturated sections of sand.

Proration of daily-allowed oil for the pool is upon an acre-lb. basis, commonly known as acreage-times-pressure. The daily allowable for the pool is distributed to wells and leases in the proportion that the acreage assigned to the well multiplied by the bottom-hole pressure assigned the well bears to the sum of such products for the pool.

As noted in the closing paragraphs of this article, this method of allocating production has not been used throughout the life of the pool and accounts, together with development, for established pressure patterns.

There are 12 owners of production in the Jones pool at present. Their respective wells, assigned producing acreage, and daily allowables are shown in Table I. The location of these wells and leases is illustrated in Fig. 1.

Production Data

The Jones pool was discovered September 17, 1937, by the Edwin M. Jones well, No. 1 Marine, NW SW SE sec. 17-18-17, in the southeastern part of the structure. The pool appears to be elongated in a northwest-southeast direction and is now apparently fully defined and almost completely developed, as only one well is now drilling.

The average elevation of the ground is approximately 250 ft. above sea level. The highest point of the producing sand has been found at a subsea depth of minus 7251 ft.; original gas-oil contact at about minus 7270 ft., and the water level varying from minus 7370 to minus 7380 ft.

The areal extent is approximately 3900 acres of oil- and gas-bearing formation of which approximately 800 acres, in equivalent, comprises the gas cap. The pool now contains 139 wells, two of which are edge pumpers. Pumping wells are to be expected as the sand has a tendency to grade laterally into shale toward the eastern edge of the pool.

The spacing of the wells follows an unusual pattern of two wells to 40 acres in alternate opposite corners of the 40-acre tract. A 10-acre tolerance is provided in the ruling on 20-acre spacing.

Original reserves were computed to be approximately 220 bbl. of oil per acre-ft., or a total reserve, based on 35 percent recovery, of 42,500,000 bbl. of oil.

The pool has produced 8,992,500 bbl. of reported oil to September 1, 1939, and 8,740,710,000 cu. ft. of gas. The average gas-oil ratio throughout the life of the field has been 972 cu. ft. per bbl.

Fig. 3. Total reservoir pressure decline, illustrating the hydraulic gradient existing across the reservoir due to withdrawal and low varied permeability. Scale—1:12000

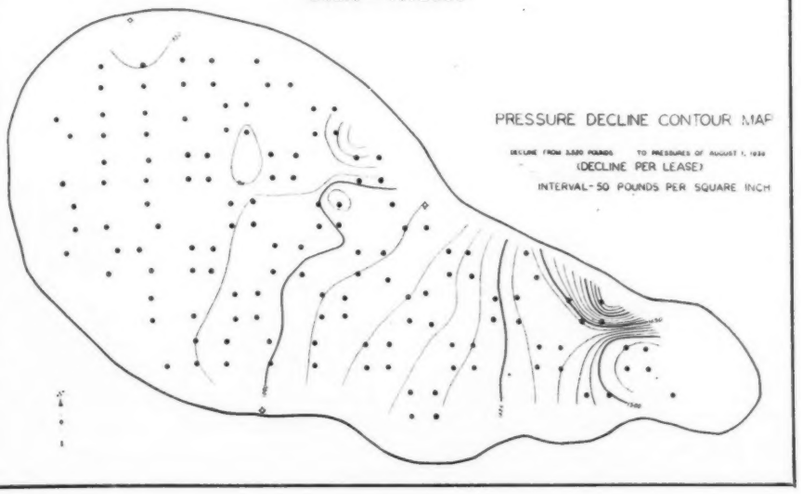
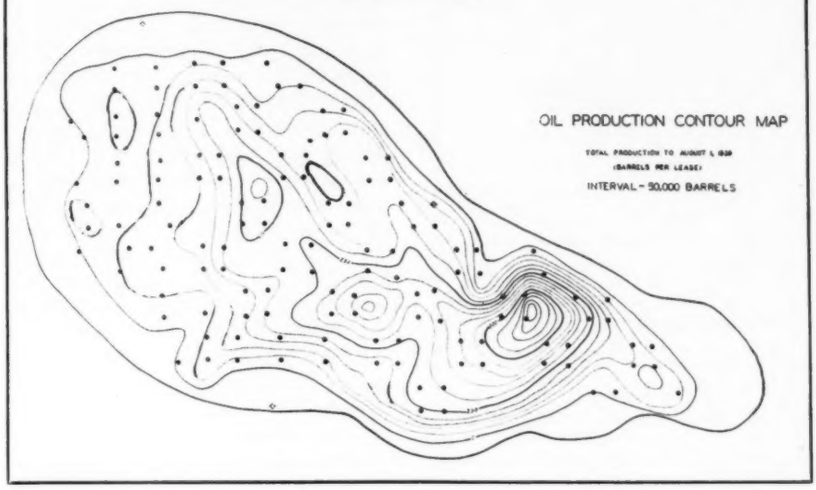


Fig. 4. Areal production contour map, illustrating areas of concentrated withdrawal following development of pool. Correlate with Fig. 3. Scale—1:12000



The bottom-hole pressure has declined from an initial of 3520 lb. per sq. in. to 2462 lb. (September 2, 1939), a total loss in pressure of 1058 lb. per sq. in.

The recovery of oil has been 8500 bbl. per lb. loss in reservoir pressure.

The oil produced is of paraffin base and is fully saturated by gas in the reservoir. It has a gravity of from 32 to 34.6 deg. A.P.I. and a sulphur content of about 1.5 percent.

The gas produced has an average specific gravity of 0.86, a gasoline content at atmospheric pressure of 1.5 gal. per M. cu. ft., and a hydrogen sulphide content of approximately 60 grains per 100 cu. ft.

The formation consists of from 14 to 80 ft. of permeable, porous oil and gas sand whose average thickness is approximately 50 ft.

Porosities vary upward to 23 percent, the possible approximate average being 17.6 percent.

Solubility-shrinkage and sand volume methods of computing reserves have agreed closely, on the assumption that the connate-water content is approximately 15 percent.

Shrinkage at 3436 lb. per sq. in. and 198°F. (based on residual oil) was found to be 34.8 percent, resulting principally from the liberation of 762 cu. ft. of gas per bbl. of residual oil.

Permeability will vary horizontally from a possible maximum of 3000 millidarcys and will average approximately 400 millidarcys.

Core saturation varies from a maximum of 30 percent and will average approximately 13 percent. Chloride content ranges from a maximum of 6000 to a minimum of 71 p.p.m.

In the majority of the wells, 16-in. conductor pipe was set at a depth of about 115 ft. using 125 sacks of cement, 10¾-in. casing was set at about 2000 ft. using 1000 sacks of cement, and 7-in. casing was set on bottom using 1000 sacks of cement.

The 7-in. oil string in most instances is set below the producing formation; an average of 115 gun perforations being made low in the oil-saturated section of the producing sand. This practice explains the relatively low gas-oil ratios.

The wells are producing their daily-allowed oil through 2½-in. tubing and chokes of proper size. It is thought that the present relatively low allowables, produced over a 24-hr. period, are resulting in slippage to some extent, and explains the slight overall increase in gas-oil ratios and the rec-

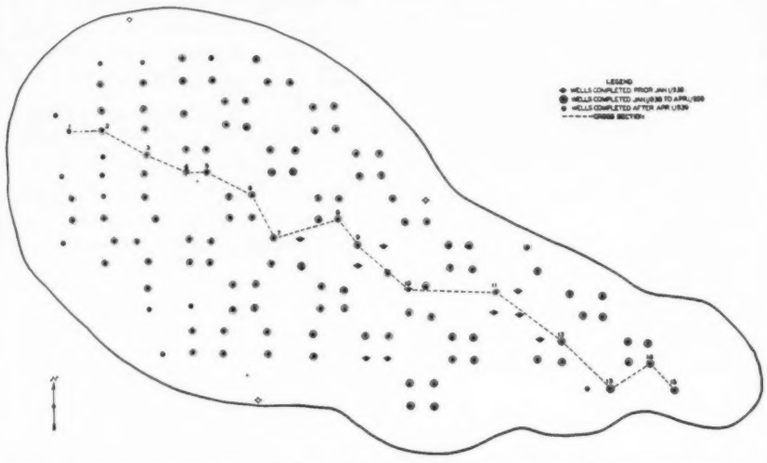
TABLE 1
Allowable Data from September, 1939, Schedule

Company	No. wells	Acreage	Percent of total acreage	Allowable	
				Bbl.	Percent
Alice Sidney Oil Co	6	122	4.36	661	4.41
Atlantic Refining Co	3	60	2.14	264	1.76
Bailey & Trimble	1	20	0.715	113	0.753
Crescent Drilling Co	1	20	0.715	87	0.582
Delta Drilling Co	1	20	0.715	90	0.602
Edwin M. Jones	17	350	12.50	1,826	12.17
Lion Oil Refining Co	60	1208	43.14	6,595	43.97
Marine Oil Company	10	208	7.43	1,113	7.42
J. K. Mahony et al	2	40	1.43	227	1.51
Phillips Petroleum Co	35	692	24.71	3,710	24.73
Roberts & Murphy	2	40	1.43	225	1.50
Texas Canadian Oil Corp	1	20	0.715	89	0.593
Total	139	2800	100.0	15,000	100.0

TABLE 2
Maximum and Minimum Bottom-Hole Pressure and Gas-Oil Ratio Data by Months

Date	Bottom-hole pressure, lb. per sq. in.		Difference	Gas-oil ratio, cu. ft. per bbl.		Difference
	Maximum	Minimum		Maximum	Minimum	
Sept. 1937	3520	3520	0	600	600	0
Jan. 1938	3509	3216	293	800	500	300
Feb. 1938	3400	3196	204	850	500	350
Mar. 1938	3384	3120	264	5503	512	4991
Apr. 1938	3310	2924	386	3570	508	3062
May 1938	3259	2924	335	3600	510	3090
June 1938	3320	2938	382	1700	520	1180
July 1938	3250	2782	468	1725	530	1195
Aug. 1938	3230	2755	475	1800	550	1250
Sept. 1938	3115	2520	595	1775	600	1175
Oct. 1938	3060	2395	665	1820	625	1195
Nov. 1938	3095	2320	775	2067	500	1567
Dec. 1938	3060	2310	750	2352	311	2041
Jan. 1939	3030	2225	805	3620	439	3181
Feb. 1939	3005	2250	755	2257	312	1945
Mar. 1939	2910	2146	764	2195	420	1775
Apr. 1939	2832	2090	742	1899	489	1410
May 1939	2805	2030	775	1990	510	1480
June 1939	2615	1925	690	1790	510	1280
July 1939	2630	1985	645	1948	545	1403

Fig. 5. Identification map of NW SE cross-section to illustrate position of wells contained in Table 3 and Fig. 6. Scale—1:12000



ommendation that stop-cocking be followed.

Early productivity tests indicated that the drop in reservoir pressure at various flow rates may be a nearly linear function of the rate up to 88.7 bbl. per hr. Specifically, the productivity index decreases from 6.0 at 21.5 bbl. per hr. to 5.3 at 39.7 bbl. per hr., and to 5.0 at 88.7 bbl. per hr. If this relation extends to high rates, we may estimate that at 200 bbl. per hr. the reservoir pressure drop would be 1600 lb. (productivity index = 3), corresponding to a flowing pressure at a depth of 7590 ft. of about 1850 lb. The flow data show that the most efficient rate of flow is at the low rates.

The engineers of the Commission test 22 key wells to determine the bottom-hole pressure of the pool each month. Standard Oil Company of California depth-pressure gauges are used in this work and portable Anubis orifice meters are employed in determining operating gas-oil ratios.

Gas-oil ratios are taken on each well each month while the wells are producing the daily-allowed oil.

Bottom-hole pressures are taken over a 2-day period after the wells have been closed to production for at least 24 hours. The method of determining the bottom-hole pressures that has been followed for the last year, may be described briefly as follows: One half of the field is closed to production for 24 hours and the key wells tested, then while the first tests are being run the other half of the field is closed and tested the following day.

Areally weighted pressures are derived by posting the observed pressures on a map, and then contouring and planimetering.

Pressure—production—gas-oil ratio relationship is visualized in Fig. 2. On the same chart, progressive well completion is shown.

The original reservoir pressure (3520 lb. per sq. in.) was 183 lb. in excess of a hydrostatic head due to fresh water but corresponds to a hydrostatic head due to salt water having the gravity of Jones Sand formation water.

As can be observed from Fig. 2, the decline in reservoir pressure has been fairly rapid and persistent since initial development. Decline centers about the discovery section of the pool and follows the path of development in a westerly direction, as can readily be visualized from Fig. 3.

As production begins when the first well is completed and pressure decline is a function of withdrawal or production, especially in a gas-driven reservoir of varied and low permeability, it is natural to expect the conditions depicted in Figs. 3 and 4. Both these figures were drawn by using the center of the individual lease as contour points.

Referring again to Fig. 2, it may be noted that weighted average bottom-hole pressures and gas-oil ratios follow a fairly definite trend. This may be misleading information in that there has been a comparatively wide gradient in pressure and gas-oil ratio that has existed throughout the life of the pool. The maximum and minimum in both pressure and ratio are tabulated in Table 2.

Aside from reducing or varying allowables, these differences in gas-oil ratio have added to the cost of production. The operators have performed

TABLE 3
Difference in Allowables Across Pool
(See Figs. 6 and 7 for well location)

Key No.	Assigned acres	Pressure, lb. per sq. in.	Daily oil, bbl.
1	20	2620	114
2	20	2620	114
3	20	2625	114
4	28.2	2610	159
5	20	2595	113
6	20	2580	112
7	20	2570	111
8	13.3	2535	73
9	27	2525	148
10	20	2430	105
11	20	2275	99
12	20	2195	95
13	20	2085	90
14	20	1985	86
15	20	1985	86

TABLE 4
Comparison of Proration Periods

	Period 1	Period 2	Period 3
Production of oil	346,567 bbl.	6,567,394 bbl.	2,078,539 bbl.
Producing wells at end of period	8	122	138
Producing well-days	253	30,855	18,110
Production: Well/Well-Day	1,369 bbl.	213 bbl.	115 bbl.
Assigned acreage	400 acres	2,522 acres	2,781 acres
Production per acre	866 bbl.	2,604 bbl.	747 bbl.
Bottom-hole pressures:			
Beginning	3,520 lb.	3,420 lb.	2,640 lb.
Ending	3,420 lb.	2,640 lb.	2,462 lb.
Pressure decline during period	100 lb.	780 lb.	178 lb.
Oil Produced: Bbl. per lb. drop	3,465	8,419	11,677

numerous "squeeze-jobs" to correct high gas-oil ratios at an average cost of $6000 per well.

The cost of drilling and equipping a well in the pool is approximately $70,000 and the production cost averages 22 cents a bbl. at the present time. The market price ranges from 79 to 81 cents a bbl.

The cost figures will again be increased materially prior to the pumping stage, due to the necessity of correcting, mechanically, gas-oil ratios. The ever-expanding gas cap will increase ratios eventually over the entire pool.

Varied Well Allowables

The information contained in Figs. 6 and 7 affords a good production picture not only historically, but of the difference between wells from northeast to southwest across the pool. Table 3 shows the difference in allowed oil to these wells during the month of September, 1939.

Although the information in Table 3 shows quite a difference in allowables, it does not truly reflect the extreme, which is from 165 to 30 bbl. daily. That is a difference of 450 percent between the best and poorest wells.

It must be remembered that at the present rate of pressure decline the wells low on structure will require the installation of pumping or gas-lifting equipment very soon, but the wells higher on the structure will have a natural recovery many times greater.

A relationship between sand thickness, withdrawal, and pressure decline is very evident from a study of Figs. 5 and 6. The reason for more rapid decline of pressure in the thinner sections, without replenishment, is due to the varied horizontal and vertical permeability. The permeability varies greatly between and in wells.

Another reason to prevent uniform migration of pressure is the spacing pattern. This is brought out in the isopach (thickness) map in Fig. 7, on which the values for the producing wells are determined by the variation in thickness that exists throughout the area enclosed by each group of eight wells.

The negligible change in pressure across the pool is illustrated by the lines of comparative pressure in Fig. 8.

The data for Fig. 8 were obtained by the engineers of the Commission on August 23 and September 2, 1939, during the state-wide shut-down. Although an increase of 16 lb. per sq. in. was indicated upon an areal basis, when the maps were weighted volumetrically, based on the estimated formation thickness, the pressure remained almost constant during the period.

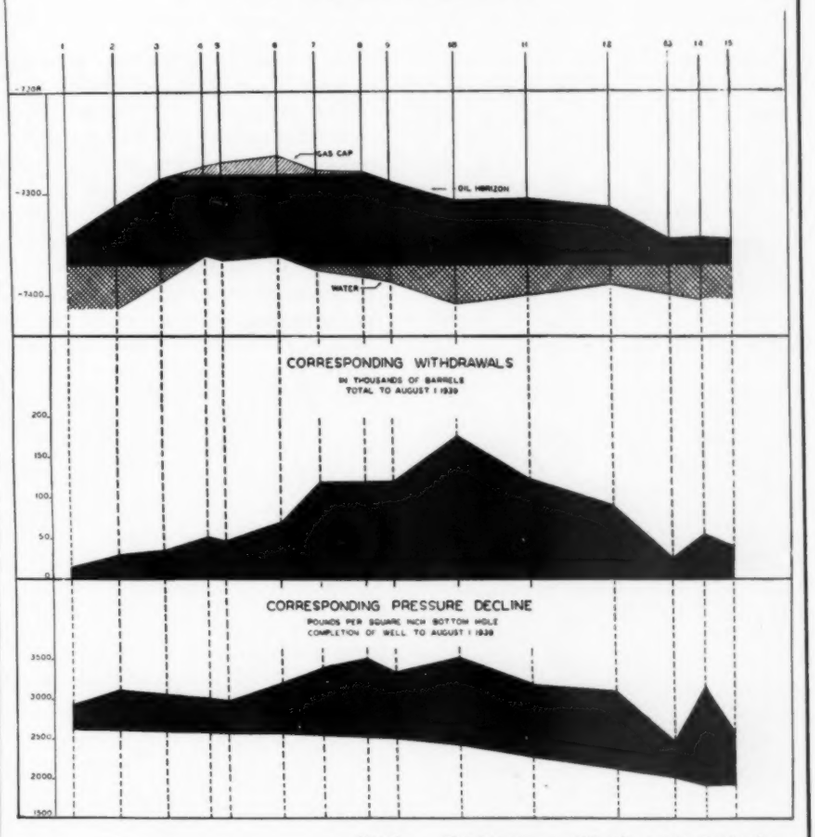
The fact that there was little change in reservoir pressure bears out the contention that no effective active water drive exists, the flow apparently being derived entirely from the energy of the gas in solution.

Some alarm has been expressed over what has appeared to be an excessive decrease in pressure, particularly in the eastern section of the pool. This pressure decline has been fairly rapid, persistent, and definite since production began.

The pressure contours illustrated in Fig. 8 are not alarming when viewed from the standpoint of withdrawals and in proportion to recoverable reserves. The contours merely represent a natural hydraulic gradient established by slow fluid movement in a low permeable sand.

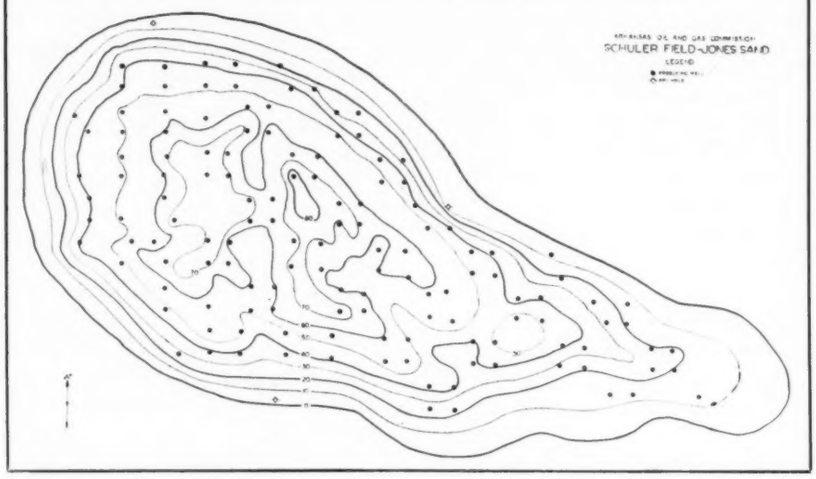
The cumulative withdrawal of approximately 9,000,000 bbl. of oil represents a production of approximately 20 percent of the estimated recoverable oil from the entire pool although, due to early development, much more than 20 percent of the estimated reserves has been withdrawn from the eastern section.

Fig. 6. Behavior chart, NE SW cross-section. Profile of total withdrawals, pressure decline, sand thickness, and time (producing well-days). Key is Fig. 5. Scale—1:12000



No.	*Company*	*Well*	*Total withdrawals, bbl.*	*Total pressure decline lb. per sq. in.*	*Effective sand thickness, ft.*	*Producing well-days*
1.	Lion Oil Ref. Co.	Clay No. 1	14,012	310	43	113
2.		Bank No. 1	30,988	495	47	244
3.		Henry No. 1	37,050	455	69	285
4.		Sewell No. 1	53,464	420	77	328
5.		Mayfield No. 6	47,489	405	71	281
6.		Mayfield No. 2	71,994	670	63	426
7.	Phillips Pet. Co.	Justiss No. 2	122,208	845	65	536
8.		Jennings No. 1	122,858	974	69	561
9.		Rosen No. 2	122,757	835	56	493
10.	Alice Sidney	Morgan No. 2	179,330	1100	57	610
11.	Phillips Pet. Co.	National No. 1	125,587	916	39	520
12.	Lion Oil Ref. Co.	Marine No. 2	92,799	975	35	491
13.	Delta Drlg. Co.	Powledge No. 1	27,756	975	14	257
14.	Atlantic Ref. Co.	Dumas No. 1	55,300	1225	14	395
15.		Dumas No. 2	43,400	670	17	310

Fig. 7. Isopach thickness of oil saturated sands only (prepared from testimony presented at hearing July 27, 1939). Estimated thickness of producing formation minus shale breaks and gas cap. Scale—1:12000



Depletion of the oil reserves or the reservoir energy is not directly proportional to pressure decline. In other words, a pressure decline of 1200 lb. from an initial pressure of 3500 lb. does not indicate that either the recoverable reserves or the reservoir energy has been depleted by one-third. A pressure drop from 3500 to 2300 lb. indicates an expansion of the reservoir gas to approximately 1.5 times its original volume. The expansion that takes place between 3500 lb. and 100 lb. will increase the gas volume approximately 35 times. As the energy required to move oil into the well-bore will be obtained primarily from gas expansion, it is obvious that only a small proportion of the total reservoir energy has been expended at the time a well is ready for the pump. The fact is, at progressively lower pressures, the work obtained from gas expansion will be less efficiently utilized, and this illustration is used only to indicate the relatively small amount of reservoir energy utilized during a well's flowing life.

Obviously, then, at the present rate of pressure decline, it would be desirable to prolong the flowing life of the pool by some form of pressure maintenance. Also, experience elsewhere has indicated that the ultimate recovery can be increased by 15 percent, and that it is economically feasible to return gas to the formation.

The wells are ideally spaced for gas injection but, unfortunately, diversity of ownership in any pool makes the realization of such a project extremely difficult in the absence of unit operation under a unitization agreement for the entire pool.

As early as October, 1938, definite proposals for pressure maintenance were considered but no agreement reached. Some of the objections were (1) its high cost, (2) distribution of expected benefits, (3) the method of application, (4) doubt as to the ultimate outcome in a reservoir of low migratory characteristics, (5) change of natural equities, and (6) inability to reach a unitization agreement.

Pressure reduction has not yet reached a point at which pressure maintenance is impracticable, but it is doubtful whether a pressure-maintenance plan can be devised that will prove successful without unitization, which at this time appears impossible.

It is believed that operation of this gas-driven reservoir under proration has been increasingly gratifying. As has been explained, the time element and the beneficial effect of early development is more pronounced in a reservoir of this type than any other. The fact that in a gas-driven or volumetrically-controlled reservoir the energy source is expended in a reverse direction, reversing also the position of favorable leases when compared to a water-driven or hydraulically-controlled reservoir, thus makes the balancing of production or allowables to equity difficult. The further fact that experience has inured the operator to thinking in terms of water-drive behavior presents another difficulty.

Development of Arkansas Proration

When the Jones pool was discovered there was no comprehensive conservation statute in Arkansas. The control of production, or proration, has been divided into three separate and distinct periods.

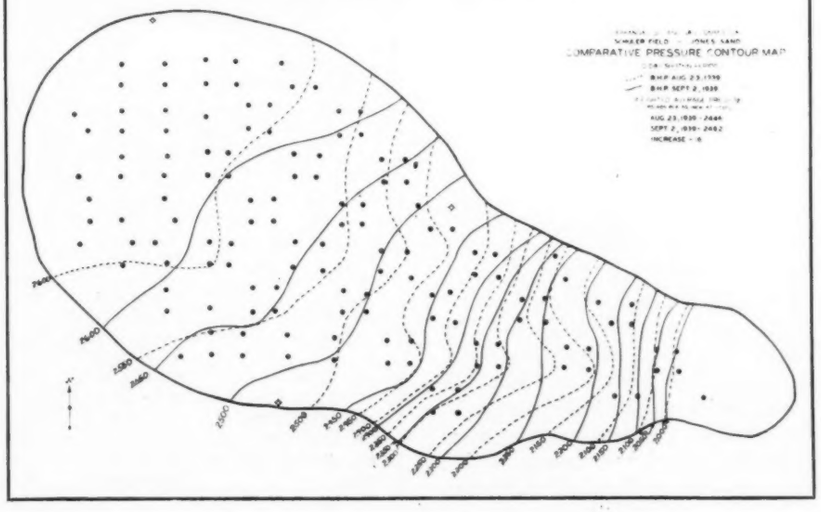
Period 1—Unregulated—September 17, 1937, to January 1, 1938.

Period 2—Operators' Agreement—January 1, 1938, to April 1, 1939. During this second period allocations were based on *acreage plus pressure*, equally weighted.

Period 3—Legislative—April 1, 1939, to present. *Acreage times pressure allocation* being used.

Although it would be difficult to evaluate, as a whole, the relative worth of these various periods of production, due to the difference in production practice intervening, a comparison can be made, nevertheless, as in Table 4. The rate of decline in reservoir pressure per unit volume of crude oil produced certainly indicates worthwhile progress.

Fig. 8. Static comparative weighted pressure, illustrating the change in areas of differential pressures over a ten-day shut-in pressure; entire pool closed to production. Scale—1:12000



Record of Penetration Rate Should Aid in Drilling-Time Studies

New instrument facilitates recording of rate of penetration in rotary drilling

By H. LEE FLOOD
Associate Editor

IT is generally recognized that present-day drilling equipment represents the investment of a small fortune to the company or contractor who wishes to undertake the drilling of an oil well. It is also admitted, in principle, but too often disregarded in actual practice, that the difference between economical drilling cost and exorbitant drilling cost is usually composed, not of a few glaring, obvious points of inefficiency, but of minor "leaks" that may occur continuously or recur many times a day to bring about generally poor drilling results and send the costs sky-high. The unfortunate thing about it, too, is that the driller or toolpusher is as much at a loss to explain the causes after the well is completed as he was to recognize the existence of these causes while they were occurring.

The above remarks, of course, apply to the drilling operation that is conducted in hit-or-miss fashion, and that, unfortunately, is still too often the rule rather than the exception. In direct contrast to the companies and contractors who are still adhering to these slipshod methods are those who are alert to the dollars to be saved and are aggressive in studying and developing new methods of analyzing and controlling the use and operation of the massive drilling rigs that now exact such a heavy penalty for every moment of delay and for every foot of hole not intelligently drilled.

Instruments Now Provide Essential Data

Gradually over the last few years, in answer to the need for precise information concerning the vital factors affecting drilling economics, methods and instruments have been devised and perfected that are now available to the drilling company who will but use them, to present a graphic picture of the results obtained.

Perhaps the first instrument to gain widespread acceptance among drillers was the weight indicator, devised principally to aid in eliminating the crooked hole resulting from a badly-flexed drill-pipe string. In use, it has developed that the weight indicator also serves to record and thus aid in controlling one of the most important factors in the weight-speed relation governing economic drilling.

Other instruments and processes developed to aid the further study of drilling factors include the torque recorder, the table-speed tachometer, instruments for measuring deviation of crooked holes, electrical logging, mud analyzers, and, more recently, instruments that will warn of the imminence of oil and/or gas in the formation being drilled.

New Instrument Records Rate of Penetration

Before describing the recently-introduced rate-of-penetration recorder, it is interesting to reflect that, of all the elements involved in drilling, instruments have been developed for measuring or recording most of the single contributing factors but the most important end-result, the one that spells profit or loss most quickly—rate of penetration—has been the last to receive attention. Speed of rotation, weight on bit, or any other single factor means little in itself except as it affects the rate at which the hole is deepened.

In principle, the rate-of-penetration recorder is perhaps the simplest instrument that could be designed for the purpose. The weight of a column of liquid is used to measure the height of

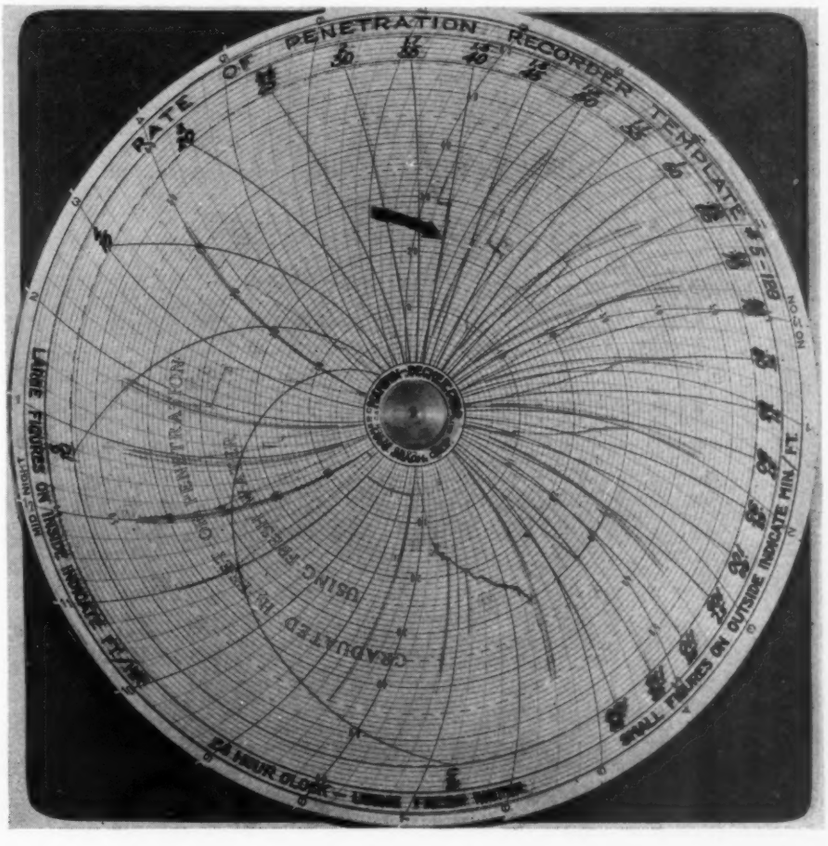
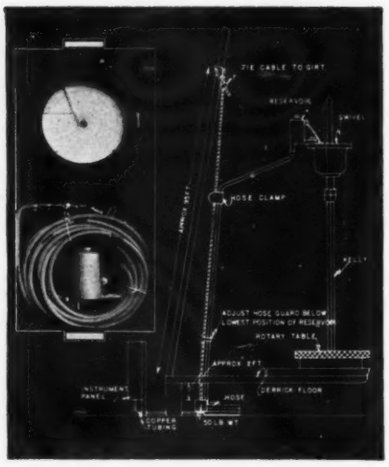


Chart mounted on jig underneath transparent template. Note coincidence of line on chart with 40-ft.-per-hr. curve on template

the rotary swivel; as the hole is deepened, this height is recorded on a chart revolving at a known rate and thus provides automatically a record of the number of ft. of hole drilled per unit of time.

In accordance with the simplicity of the principles involved, the instrument is comprised of only three parts: (1) a liquid reservoir attached to the swivel, connected by (2) a length of small-diameter rubber hose to (3) a special recording low-range pressure gauge, the charts of which are graduated in "feet of penetration." The reservoir and rubber tubing is filled by clear water or by anti-freeze solution in cold weather. An accompanying illustration shows the general arrangement during drilling. The rubber hose is supported by a small cable clamped to a derrick girt above the upper working limit of the kelly and held taut by a 50-lb. weight hanging beneath the derrick floor. The recording pressure gauge may be mounted in any convenient position.

An important accessory to the recording instrument is the template used to analyze the charts. The template, made of celluloid, is graduated by curves representing various rates of drilling, expressed both in ft. per min. and in ft. per hr. In an accompanying illustration, the template is shown, underneath which is a chart that is being analyzed. The relative shapes of the curves bring out clearly the fact that fast drilling rates are represented by lines having only slight curvature, i.e., the line traced as the swivel (and kelly) travels downward is completed during only a relatively small rotation of the chart. Conversely, a slow rate of drilling is represented by a line having a greater curvature, inasmuch as more time is required for the swivel to complete its downward travel and, likewise, a greater amount of the chart revolves while the line is being recorded. On the chart being analyzed, it may be noted that the arrow points to one line on the chart that coincides exactly with the 40 ft. per hr. curve on the template. The almost parallel closely-spaced lines occurring periodically represent, of course, the travel of the swivel in coming-out of the hole to raise the kelly, of lowering to pick-up the next stand of drill pipe, and of lifting the stand into position to be made-up.



Arrangement of recorder at drilling well. Inset shows recorder in box ready for moving

Application of Penetration Data

The accompanying graph is a representative portion of the drilling record on a well drilled in California, on which the rate-of-penetration recorder was used. The record is for that portion of the drilling between the depths of 4500 and 5450 ft.

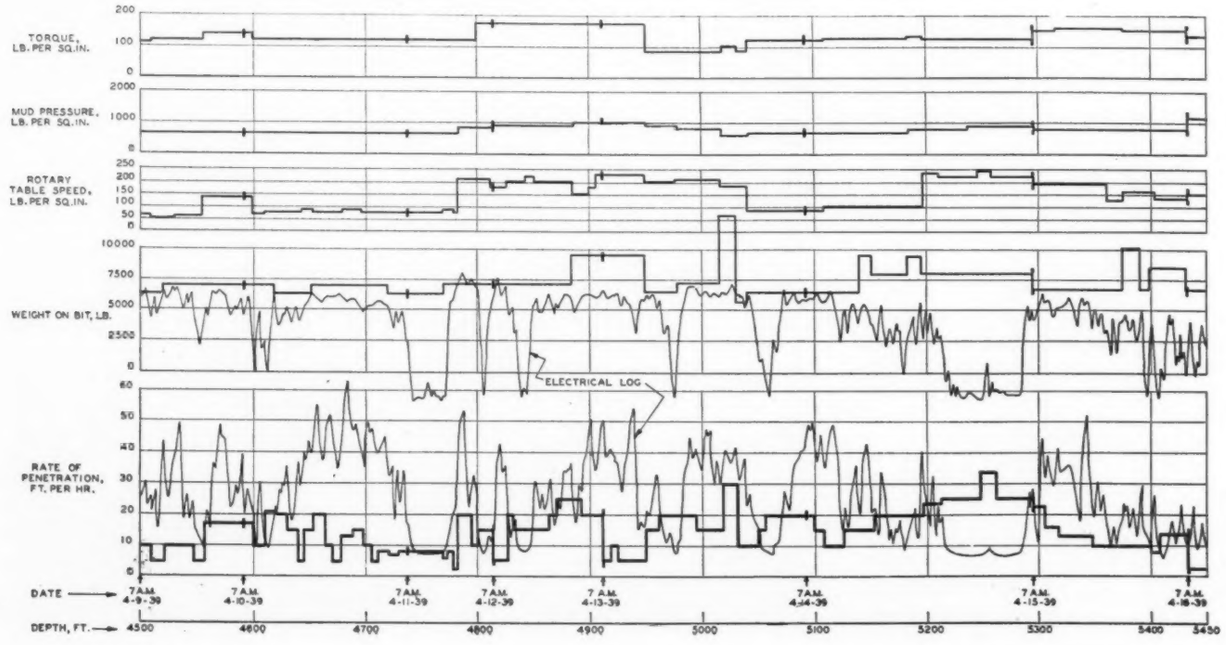
A study of this composite record, in which are combined the values recorded by the various instruments, including the electric-log readings, shows the value of having a definite, accurate record of the rate of drilling.

The principal value of the new instrument is that no longer will it be necessary to depend upon the driller's measurements and records for information concerning the speed of drilling.

Sensitive to every slight variation in the rate of downward travel of the bit, the instrument provides a graphic record of every change in drilling characteristics of the formations being drilled.

Of interest and value in the record of a single well, the real value of the new instrument will be in the results that should come from a correlation of the records in a large number of wells drilled over a period of time. Various combinations of table speeds and weights on the bit and other important variables may be tested and the results now always interpreted in the comparable terms of penetration rate as recorded.

Correlation of penetration data with other records obtained on drilling well in California



STATEMENT OF POLICY

The world is entering a crisis, the result of which no one can foresee. Other wars have brought inflation, followed by unemployment and depression after peace was achieved. America's experience in the World War illustrates this fact.

Much of this post-war trouble would have been eliminated by a more foresighted price policy on the part of manufacturers and distributors. Price inflation by the seller when he had a dominant position resulted inevitably in reaction with deflation, depression and suffering. Many of those price increases were not warranted.

Before such an inflationary cycle of prices is again started, we publicly pledge ourselves, as far as possible, to maintain present prices.

Further, if the materials we buy are increased in price, or the cost of labor is increased, then we pledge ourselves to raise selling prices no more than the bare increase in cost of raw materials and labor going into our products.

Further, we pledge ourselves to pass on to our customers the reduction in cost made possible by better manufacturing methods, wider distribution and technical advances in production.

THE LINCOLN ELECTRIC COMPANY

Cleveland, Ohio
October 2, 1939

J. F. Lincoln
President

The Development of Anti-Knock Motor Fuel

Part 2 (Concluded)

By A. W. TRUSTY
Chief Chemist, Arkansas Fuel Oil Company

OBVIOUSLY, most economical operation is obtained when the engine has a perfect air-fuel ratio and a fuel is used that will not cause a knock under this air adjustment. Commercial engines, however, usually are operated on a richer mixture than the theoretical mixture.

Fig. 10 shows the effect of cylinder size on detonation. Other conditions being the same, the detonation will be less pronounced in a small cylinder than in a large one. A small cylinder can be cooled more easily than a large one, which means that the cylinder temperatures will be lower and consequently the knocking will not be so severe.

Tetraethyl Lead

The refiner at the present time has two general methods that may be used commercially for improving the anti-knocking qualities of motor fuel:

1. The addition of a chemical, such as tetraethyl lead, alcohol, benzol, iron carbonyl, or some concentrated mixture of aromatic hydrocarbons.
2. Changing the nature of the hydrocarbon structure of the gasoline by cracking, reforming, polymerizing, hydrogenating, or isomerizing.

Both of the above methods are in general use; in fact, in most plants, both methods supplement each other. By far the most widely used anti-knock additive chemical is tetraethyl lead.

The value of tetraethyl lead as the most effective anti-knock agent known was discovered in 1921 by Midgley and Boyd in the Research Laboratories of the General Motors Corporation. The research work leading to this discovery was suggested by Kettering of the same company. A small lighting plant had been developed by the company for use on farms and in other places where electric power was not available. The engine was designed to operate on gasoline, but the storage of such a volatile fuel on the premises was objected to by the underwriters. Kerosene was substituted and at once it was recognized that the compression ratio had to be lowered, with its consequent loss of power output, in order to operate the engine without the objectionable knock. As a result of the research work and after the investigation of thousands of chemical compounds, tetraethyl lead was adopted as the most practicable and effective anti-knock agent.

Tetraethyl lead was first distributed in 1921. At first the fluid was dispensed from a proportioning device at the retail pump, but the sale was voluntarily discontinued for several years. Because of the poisonous character of the fluid, a committee was appointed by the United States Public Health Service to investigate the health hazards involved in the retail distribution of leaded gasoline. The report of the committee appeared in 1926, and it was concluded that there were no grounds for prohibiting the use of ethyl gasoline as a motor fuel, provided its distribution and use are controlled by proper regulations. The Ethyl Gasoline Corporation has been very conscientious in the enforcement of safety regulations. The men working as ethyl blenders are examined twice a year by a doctor. Because of the precautions that have been taken at the blending plants, there have been no deaths or illness due to lead poisoning.

A biographical sketch and photograph of the author can be found on page 106 of the September issue of *The Petroleum Engineer*, in connection with Part 1 of this article.

Ethyl fluid is received at the blending plant in drums or tank cars. The ethyl blender uses a gas mask, rubber gloves, hip boots, and white coveralls. A proportioning pump discharges the fluid and the gasoline into a mixing tank through a perforated coil spray. The contents of the tank are stirred by a circulating pump until they are well mixed.

An analysis of the concentrated fluid is as follows:

	Percent
Tetraethyl lead	63.3
Ethylene bromide	25.7
Ethylene dichloride	8.7
Dye, etc.	2.3

The fluid is entirely soluble in gasoline and has a specific gravity of 1.65 (13.7 lb. per gal.). The bromine in the ethylene bromide combines with the lead oxide during the combustion, forming lead bromide, a volatile compound that is removed from the engine cylinder with the exhaust gases. Thus the lead is not permitted to coat the spark-plug points and cylinder walls. Tetraethyl lead in the amount of 3 cu. cm. per gal. of gasoline is the maximum amount that can be used except in certain grades of aviation gasoline.

Iron and Nickel Carbonyls

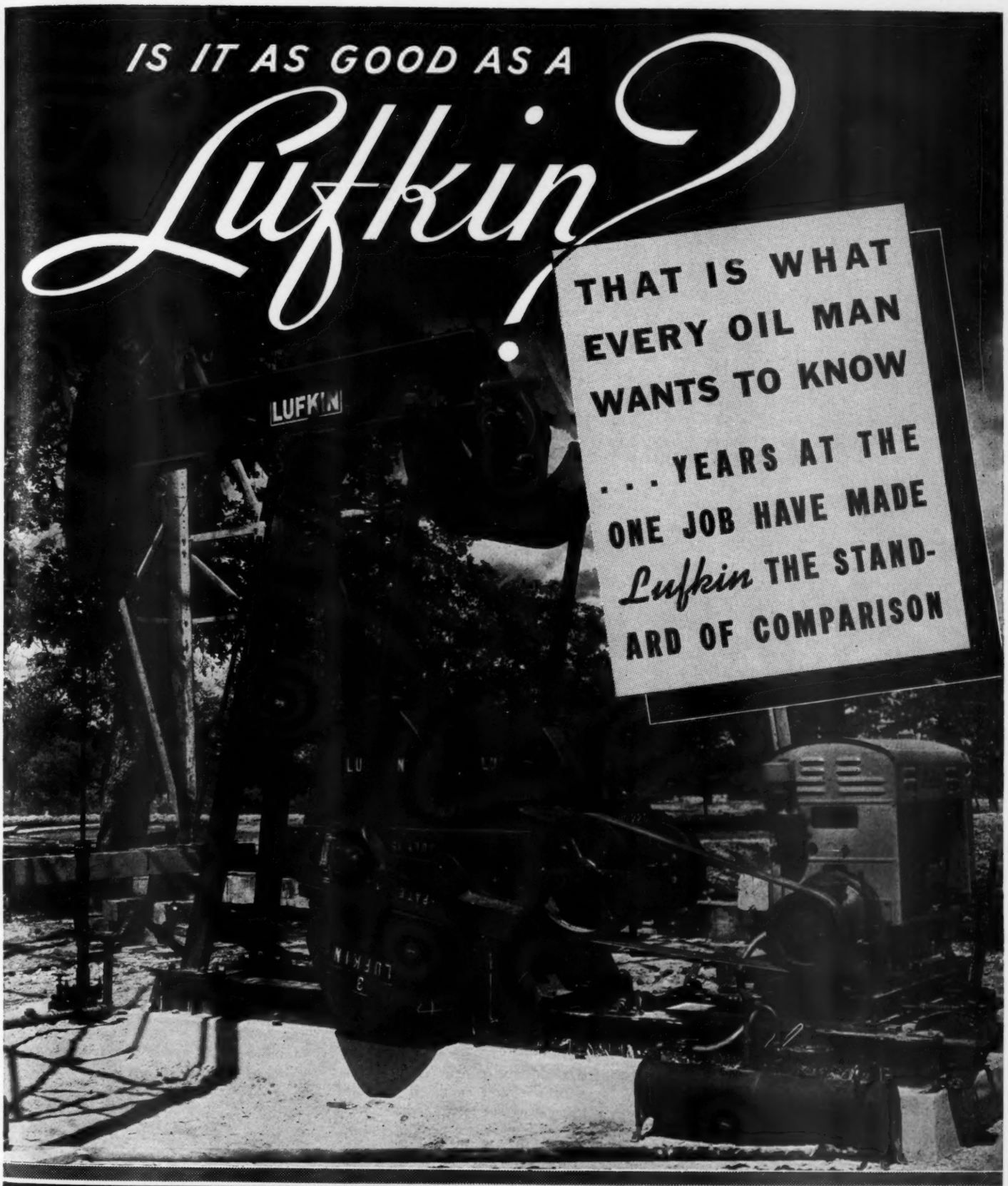
Although they are effective anti-knock agents, second only in effectiveness to tetraethyl lead, iron and nickel carbonyls have not been developed for this purpose to the same state of perfection as has tetraethyl lead. In Germany, iron carbonyl has been marketed in the motor fuel "Motyl," but not to any great extent because of the iron oxide that is deposited on spark plugs and valve stems.

Iron carbonyl is a yellowish-red liquid that melts at 6°F., boils at 218°F., and has a specific gravity of 1.45; it is not stable in light. Nickel carbonyl is susceptible to moisture.

Benzol and Alcohol

Benzol has been used extensively in the past as a blending agent to produce a premium-grade anti-knock fuel. Because of the higher price and the small volume of benzol produced, the volume used as a blending agent today is small.

Alcohol has an extremely high anti-knock value. When alcohol is used alone in a high-compression engine, the anti-knock value can be utilized. In such cases, the power output is considerably higher than when gasoline is used as the fuel. As noted from the formula for ethyl or grain alcohol, C_2H_5OH, about 28.6 percent of oxygen is present. This oxygen obviously lowers the heating value when compared with gasoline. When alcohol is used either alone or as a blend with gasoline in the commercial automobile engine of moderately high compression, the fuel consumption is slightly higher and the power output is slightly lower


IS IT AS GOOD AS A
Lufkin?
THAT IS WHAT EVERY OIL MAN WANTS TO KNOW
. . . YEARS AT THE ONE JOB HAVE MADE Lufkin THE STANDARD OF COMPARISON
LUFKIN

LUFKIN PUMPING UNITS

LUFKIN UNITS are manufactured in Lufkin, Texas, by the Lufkin Foundry & Machine Company. Branches in principal oil centers

than with gasoline alone. Alcohol-gasoline blends containing about 10 percent of ethyl alcohol are marketed today in eight midwestern states.

The following table compares the properties of benzol, alcohol, and gasoline:

	Gasoline	Alcohol	Benzol
Specific gravity	.730	.825	.876
Gravity, degrees A.P.I.	62.0	40.0	30.0
Boiling point, °F.	100-400	173	176
Freezing point, °F.	below 0	below 0	42
Octane number (Motor Method)	72	140	95
Heating value, B.t.u. per lb.	21,700	12,820	17,650
Heating value, B.t.u. per gal.	135,000	84,400	125,700
Latent heat of vaporization, B.t.u.	129	368	170
Reid vapor pressure	10.0	3.0	3.2
Air-fuel ratio for complete combustion	15.1	9	13.3

Solvent Extraction

Another method of improving the anti-knock quality of a gasoline is by solvent extraction of selected petroleum fractions. This process is not used commercially today, but holds considerable promise for the future. Saegebarth, Broggini, and Steffen[1] have conducted laboratory experiments to show that by solvent extraction of naphtha with sulphur dioxide, high-octane-number concentrates can be produced. By using 70 percent by volume of liquid sulphur dioxide at a temperature of minus 60°F., a yield of 34 percent of 90 octane-number concentrate was produced from a South Texas straight-run naphtha. The characteristics and yields of the products from the solvent treatment of straight-run Mid-Continent and South Texas naphthas are:

	Mid-Continent	South Texas
Yield of high-octane naphtha, percent	9	34
Octane number, C.F.R., of naphtha	91	91
Initial boiling point, °F.	255	247
10 percent distilled at, °F	279	267
50 percent distilled at, °F	314	292
90 percent distilled at, °F.	364	337
End point, °F	414	394
Gravity, degrees A.P.I.	32.2	33.7
Unsaturates and aromatics, percent	89.1	84.0
Naphthenes, percent	3.4	6.2
Paraffins, percent	7.5	9.8

The maximum octane number that can be produced practicably by the conventional liquid-phase cracking process is approximately 70 C.F.R. The production of higher-octane-number gasolines has been attained by further developments of cracking:

1. Reformation.
2. Alkylation.
3. Polymerization.
4. Hydrogenation.

The reforming process is usually employed on low-octane-number straight-run gasolines or naphtha feedstocks. Data on a typical operation follow:

Feedstock	Straight-run gasoline, 100 i.b.p., 400 e.p., 50 octane number.
Throughput, bbl. per day	3000
Gasoline yield, percent	81 (74 octane number)
Fuel oil yield, percent	0.7 (6.8 deg. A.P.I.)
Gas, coke, and loss, percent	18.3
Coil outlet temperature, °F.	990
Coil outlet pressure, lb. per sq. in.	600

Note: No recycling is employed. The use of chemical treatment in the form of a gum inhibitor is necessary to prevent gum formation in the reformed gasoline.

When straight-run gasoline can be blended with other stocks and ethylized to obtain 72 octane-number regular-grade gasoline, it is usually more economical to use tetraethyl lead than to reform. Reforming, however, is used by many refiners to convert a low-octane naphtha into a high-octane motor fuel readily marketable.

General

Alkylation is the term applied to the combination of olefin and paraffin or saturated hydrocarbons. In this process, olefins, such as butene, propene, etc., are brought into contact with paraffins, such as i-butane, propane, pentane, in the presence of concentrated sulphuric acid. Chemical combination between the olefins and paraffins is completed, a hydrogen atom from the paraffin breaking the olefin double bond and taking one position, the other bond combining with the bond in the paraffin that was "vacated" by the hydrogen. The resulting product is a branched chain isoparaffin, much higher in anti-knock value than the straight-chain homologue of the same empirical formula. By segregating the olefin hydrocarbons in the refining gases and alkylating them, the refiner can produce a motor fuel having an octane number of 90-100; and by the addition of tetraethyl lead, a motor fuel of 100 or higher octane number can be obtained.

A process of dehydrogenating paraffins by the use of alumina catalyst activated by iron, zinc, chromium, nickel, and other metallic oxides and salts has been developed by the Shell Development Company[2]. This method of forming olefins from paraffins is the first successful process announced and offers great possibilities for the production of anti-knock fuels. The propane and butane hydrocarbons also can be dehydrogenated and polymerized by one of the conventional catalytic processes to produce isoölefins, which then can be hydrogenated to form isoparaffins. This latter method has been in commercial use for several years.

Aromatic hydrocarbons, such as benzene, toluene, and the xylenes can be formed by the polymerization of refinery olefinic gases. These aromatic stocks have high octane numbers, but have the disadvantage of having a low tetraethyl lead responsiveness and being seriously affected by high operating temperatures of the engine.

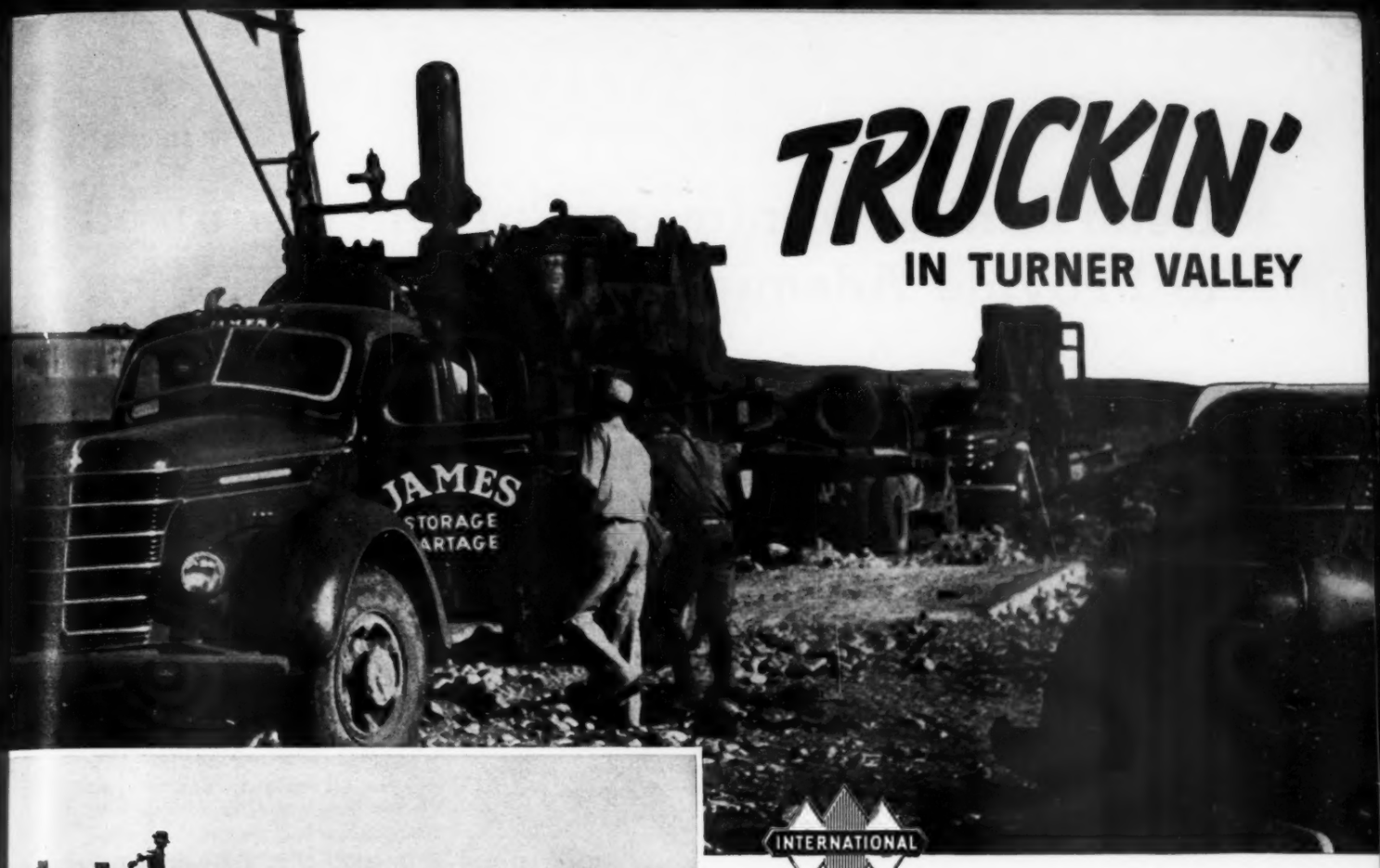
The polymerization process has been in commercial operation for more than a decade. In the catalytic process, a gas containing a high content of unsaturated hydrocarbons is charged to a furnace wherein the temperatures and pressures are comparatively low (450° F. and 200 lb. per sq. in.). The hot gases pass over a phosphoric acid catalyst and are polymerized to yield a high-octane gasoline. After fractionation and chemical treatment, or the addition of a gum inhibitor, the "poly" gasoline has a blending value of about 120 octane number.

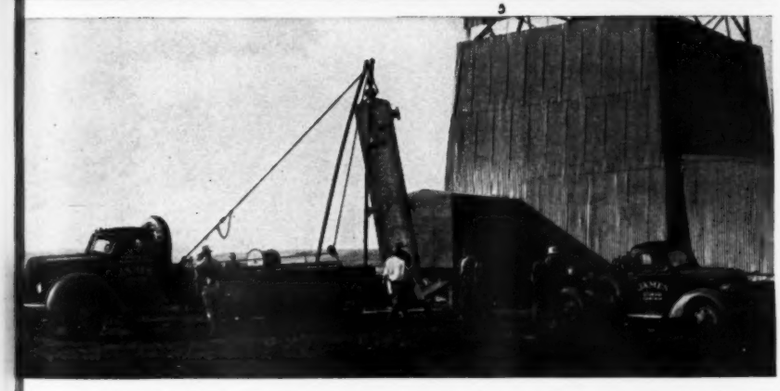
The thermal type of polymerization employs higher temperatures and pressures (in excess of 1000°F. and 800 lb. per sq. in.). The charge stock is butane and/or propane, preferably containing a high content of unsaturated hydrocarbons. No catalyst is employed. From the furnace the stock passes to a reaction chamber and thence to fractionating and stabilizing towers. After chemical treatment, or the addition of a gum inhibitor, the "poly" gasoline has a blending value of about 120 octane number.

[1] "High-Octane-Number Blending Stocks Produced by Solvent Extraction," by E. Saegebarth, A. J. Broggini, and E. Steffen. Paper presented at Seventh Mid-Year Meeting, A.P.I., Colorado Springs, Colorado, June 2, 1937.

[2] "Dehydrogenation of Lower Paraffins Over Activated Alumina Catalysts," by J. Burgin, H. Groll, and R. M. Roberts, *National Petroleum News*, p. R-432, Sept. 7, 1938.

TRUCKIN'
IN TURNER VALLEY





INTERNATIONAL

Canada's Turner Valley offers trucking conditions as tough as you'll find anywhere. And there, as in oil fields the world over, International Trucks are doing a big share of the hauling.

Internationals have been in Turner Valley almost since the field was opened. The pictures here show these trucks on typical jobs in the service of the James Storage & Cartage Co., Ltd., of Calgary. The International Diesel TracTracTor (shown at top left aiding the truck which is winching an 18-ton concrete derrick corner) is used for digging slush pits, improving roads, and a variety of other work.

The James company extended its truck service to Turner Valley in the early days of this field, and has handled the major share of trucking operations there in the area. Their continued use of International Trucks is further proof that Internationals meet the tough requirements of oil-field work. For complete information on this famous line, ranging from Half-Ton units to powerful Six-Wheelers, ask the nearby International dealer or Company-owned branch.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 North Michigan Avenue — Chicago, Illinois

INTERNATIONAL TRUCKS

P 615.635.4
P 629.14

Determining Minimum Current Required to Provide Adequate Cathodic Protection

Part I

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Application of the method will insure full protection against electrolysis without the waste of excess power sometimes employed when cathodic protection is installed blindly

By DAVE HARRELL and MILTON CLERC
Corrosion Engineers, Houston Pipe Line Company

ONE of the problems that has confronted investigators since the beginning of the electrical method of protection of oil and gas pipe lines has been to devise a yardstick that would measure the minimum amount of current necessary to provide protection. The writers in setting up a standard found so many factors had to be considered that the problem became rather intricate and it has been necessary to examine each of these factors to arrive at a solution. In describing the work done, the essential phases of the problem will be stated as they apply to the solution of the problem.

In the application of cathodic protection, as its name implies, the metal to be protected must be kept at a very definite negative potential with respect to the soil or solution in which it lies. It is difficult to picture a corrosive soil having extremely high resistance; so that if a difference of potential exists, a current necessarily must flow through the soil.

Although a negative potential of any magnitude creates some amount of protection to the cathode there seems to be a definite potential at which all corrosion ceases and any excess electrical energy supplied only results in the generation of excess hydrogen and a consequent waste of power. Previous determinations of protective potentials have been made by the loss-of-weight method on coupons under all sorts of conditions and in various kinds of soils. The objection to this method is that it results only in the definition of the *maximum* safe limit but does not determine the *minimum* safe limit, which is the factor most vitally affecting the economics of cathodic protection.

It has been stated that protective potential is correlated with the conductivity of the electrolyte or soil involved; it also follows that the conductivity in turn is dependent on the degree of ionization of the electrolyte. In recent years a potentiometric method of determining the endpoint of chemical reactions has been developed. A metal in contact with a solution of its salts will assume a potential to the solution, which is an indication of the amount of concentration of the ions of that metal in the solution in question. In this manner, a hydrogen electrode or its equivalent is used to determine the pH of an acid or alkaline solution.

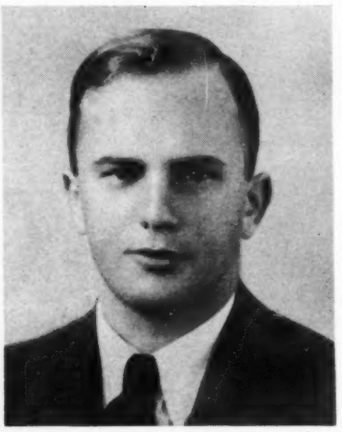
An iron electrode can be used to measure the ionic concentrations of both its salts (ferrous and ferric) in a solution. This in effect is what is done when pipe-line potentials are measured although the results are usually complicated by IR (current × resistance) decreases through the soil between the pipe and the measuring electrode.

Assume that a pipe line has been placed, unprotected, in a corrosive soil. Under these conditions very little time will elapse before a quantity of iron has been dissolved from the pipe line, resulting in a high ferrous-ion concentration and a low negative potential in

(*Continued on Page 41*)

DAVE HARRELL

studied electrical engineering at Yale and Texas universities, receiving a bachelor's degree from the latter in 1923—After graduation he spent three years in Colombia, South America, with the Tropical Oil Company, doing geological and engineering work—He returned to the United States at the end of that period to become affiliated with the geophysical department of the Humble Oil and Refining Company—His next connection was with the Reed Roller Bit Company, Houston, and when he left that company after two years to become associated with the Houston Natural Gas Company he was in charge of sales for the core bit department—He remained with the Houston Natural three years, joining the staff of the Houston Pipe Line Company in 1933.



MILTON CLERC

graduated from Tulane University in 1932, receiving a bachelor's degree in mechanical and electrical engineering—From 1925 to 1936, when not attending school, he worked as a commercial radio operator on ships all over the world, principally those plying between Europe, Asia, South and Central America and the United States—From 1936 to 1938 he was in the employ of the McCollum Exploration Company as a seismograph operator—From 1938 to date he has been in the corrosion department of the Houston Pipe Line Company as assistant to Dave Harrell.

(*Continued from Page 38*)

the adjacent soil. In a non-corrosive soil or under protected conditions only a small amount of iron is dissolved and present in the soil and hence the measured negative potential is high. Certain characteristics observed at the cathode in the application of cathodic protection to a line lying in a corrosive soil as the line becomes more and more negative with respect to the soil may be listed as follows:

1. Deposition of metallic iron on the pipe line in a finely-divided black amorphous state.
2. Increase in alkalinity in the soil around the cathode (the pipe).
3. Evolution of gaseous hydrogen from the pipe line.

Three corresponding effects of the passage of electrical current are noted at the anode, or ground-bed:

(a) Accelerated corrosion of the iron or other metal in the anode.
(b) The evolution of oxygen, chlorine, sulphur dioxide, or other acid-radical gases at the anode. (These may react immediately to form acid salts.)
(c) The increase in acidity of the soil surrounding the anode.

Taking all the above facts into consideration the following hypothesis has been developed. The potential assumed by a metal in contact with a solution of its ionized salts may be expressed by the Nernst equation:

$$E = 0.000193 \frac{T}{v} \log_e \frac{P}{P'} \quad (1)^*$$

in which:

E = potential of the electrode in volts.
T = absolute temperature, °F.
v = valence of the metallic ion.
P = solution pressure of the solid metal.
P′ = osmotic pressure of the metallic ion of the solution.

Expressed in terms of the potential of the metal with respect to the normal solution of the metal ion (not a normal equivalent solution) we have the following equation:

$$E = E_o - \frac{0.0591}{v} \log_{10} C \quad (2)^*$$

in which:

E = potential of the metal referred to the normal hydrogen electrode.
E_o = normal ionic potential of the metal in the reaction with reference to the normal hydrogen electrode.
v = valence of the ion in question.
C = ionic concentration of the dissolved metal in gram-ionic equivalents.

When the iron cathode is kept below the protective potential, there is little evolution of hydrogen and few hydroxyl ions are present at the cathode. In this case the metal acts as an iron electrode in contact with a solution of its salts. Above the protective potential line, however, decomposition of the water present and consequent evolution of hydrogen takes place. This hydrogen is "plated" on the surface of the cathode and as long as it is not removed, the iron cathode behaves like a hydrogen electrode. Also, the hydroxyl ions now become concentrated at the cathode and it may be considered as a hydrogen electrode in contact with a solution of OH— ions. Under these latter conditions it is evident that the voltage curve will then be a composite of two intersecting curves, the voltages being equal at their point of intersection.

*"Potentiometric Titrations" by Kolthoff and Furman.

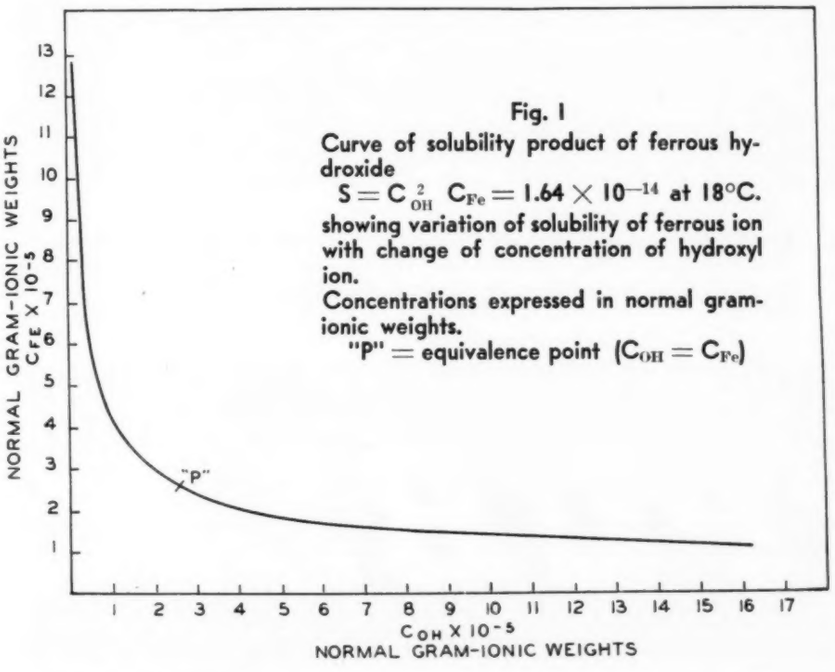


Fig. 1

Curve of solubility product of ferrous hydroxide

$S = C_{OH}^{2} \; C_{Fe} = 1.64 \times 10^{-14}$ at 18°C.

showing variation of solubility of ferrous ion with change of concentration of hydroxyl ion.

Concentrations expressed in normal gram-ionic weights.

"P" = equivalence point ($C_{OH} = C_{Fe}$)

The voltage of an iron electrode in contact with a ferrous iron solution may be expressed:

$$E_1 = E_{Fe} + \frac{0.0591}{2} \log_{10} C_{Fe} \quad (3)$$

in which:

E_1 = electrode voltage referred to the normal hydrogen electrode.
E_{Fe} = normal electrode voltage of the reaction $Fe^{o} \rightleftarrows Fe^{++}$ (referred to the normal hydrogen electrode at 25°C. = —0.441.
C_{Fe} = concentration of ferrous salts in solution expressed in gram-ionic equivalents.

Likewise the voltage of the hydrogen electrode in contact with the OH^- ions may be expressed:

$$E_2 = E_{OH} - 0.0591 \log_{10} C_{OH} \quad (4)$$

in which:

E_2 = normal hydrogen electrode voltage.
E_{OH} = normal voltage of the reaction $H^+ + OH^- \rightleftarrows H_2O$ which, when referred to the normal hydrogen electrode, is —0.8295 at 25°C.
C_{OH} = concentration of hydroxyl ions in gram-ionic equivalents.

It should be noted in the last equation that the second term is preceded by a minus sign, which indicated that the voltage increases with the OH^- concentration. Actually the electrode is a hydrogen-ion indicator but acts as an OH indicator due to the small ionic product of water that is constant for a given temperature. At 25°C. this is:

$$C_{OH} \times C_{H^+} = \text{constant} = K = 1.02 \times 10^{-14} \quad (5)$$

It follows, therefore, that for every value of C_{H^+} there is a corresponding value for C_{OH^-} as their product is a constant. Similarly the concentration of ferrous ions in a solution is governed by the hydroxyl-ion concentration, this in turn governing the solubility of the metal in the solution.

The solubility of metal in a solution is determined by the solubility of the least soluble compound of that metal capable of being formed in that solution. Thus silver chloride precipitates from a solution of silver nitrate when sodium chloride is added to it because it is the least soluble salt. By adding more sodium chloride, additional silver

(*Continued on Page 44*)

When high physical properties ECONOMICS DICTATES

The teeth of this digger were formerly cast. In some classes of service they could not stand the strain. Now they are forged from Republic SAE 6150 alloy steel. After forging they are heat-treated to 400 Brinell — with universally good results in all classes of service.

Attributes of Alloy Steels:

1. Flexibility—a steel for every application.
2. High physical properties.
3. Improved efficiency in large sections.
4. High fatigue qualities.
5. Heat-resistance—high creep strength.
6. High strength of welds.

REPUBLIC

When writing REPUBLIC STEEL CORPORATION *for further information, please address Department PT*

are indicated...

Alloy Steels

You've spent days on design. You've come out of a maze of figures with the desired tensile, yield point, elongation, reduction and hardness requirements — and the answer plainly says — alloy steels.

Despite the development of fine carbon steels and refinements in shop processing operations in recent years, the fact remains that definite limitations to the applications of such steels do exist—leaving a wide field where only alloy steels are truly economic.

When machine design limits the size of a part — when high strength must be combined with light weight — when surface hardness and ductility must be held within close limits on production parts — then alloying elements are important — to produce a steel to do a definite task — to do more work with certainty of results at the lowest cost.

There is a steel to fit your closest specification in the wide line of Republic alloys — a steel backed by the world's largest producer of alloy steels. And metallurgical advice is yours for the asking.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES: CLEVELAND, OHIO
ALLOY STEEL DIVISION: MASSILLON, OHIO

BERGER MANUFACTURING DIVISION • NILES STEEL PRODUCTS DIVISION
UNION DRAWN STEEL DIVISION • STEEL AND TUBES, INC.
TRUSCON STEEL COMPANY

REPUBLIC STEEL
REG. U.S. PAT. OFF.

WORLD'S LARGEST PRODUCER OF

Alloy Steels

(*Continued from Page 41*)

chloride is precipitated until the dissolved silver still present in solution has been reduced to a very small but finite amount and no more will be precipitated as silver chloride no matter how much sodium chloride is added to the solution. When neutralizing an acid-ferrous-ion solution by the addition of sodium hydroxide solution, ferrous hydroxide precipitates out and as more hydroxyl ion is added more ferrous hydroxide is precipitated until the saturation point is reached as described. Most of the hydroxyl ion enters into formation of the precipitate but a small amount dissociates and yields free hydroxyl ions and hence reduces the possible ferrous-ion concentration in a manner expressed in the law of constancy of the solubility product:

$K = C_{OH}^2 \times C_{Fe}$ = a constant for a given temperature . . . . . (6)

in which:

K = solubility product of ferrous hydroxide.

C_{OH} = concentration of hydroxyl ions in gram-ionic equivalents.

C_{Fe} = ferrous-ion concentration in gram-ionic equivalents.

At 18°C., $K = 1.64 \times 10^{-14}$.

Cathodic protection has the simultaneous effect of increasing the hydroxyl-ion concentration and reducing the ferrous-ion concentration at the cathode. Ferrous hydroxide would be precipitated at the cathode except for the fact that it is reduced to iron particles and these in turn are deposited on the cathode. The ferrous ions are deposited on the cathode rather than combining with the hydroxyl ions as it is generally at greater potential than the charge on the hydroxyl ion. It may be regarded, therefore, as "precipitating" due to the declining solubility of iron ions caused by an increase in hydroxyl concentration. As this so-called precipitation proceeds the point P on the curve in Fig. 1 is reached. As this point is approached and passed, the changes at the cathode may be described as follows: As the ferrous ions are deposited out of solution, their concentration around the cathode is reduced almost to the vanishing point. The process becomes accumulative as hydrogen begins to be dissociated from the water present creating more hydroxyl ions around the cathode and thus increasing the OH concentration. At the protection point, after the Fe^{++} ions have been deposited but before any appreciable hydrogen has been deposited and any appreciable quantity of hydroxyl ions accumulated, there is a definite minimum of ionization or ionic concentration at the cathode.

Let

$Q = C_{OH} + C_{Fe}$ = total ionic concentration

But from (6)

$$C_{OH}^2 \times C_{Fe} = K \text{ or } C_{Fe} = \frac{K}{C_{OH}^2}$$

Therefore

$$Q = C_{OH} + \frac{K}{C_{OH}^2}$$

To find the point at which Q is a minimum the derivative is made equal to zero.

$$\frac{dQ}{dC_{OH}} = 1 - \frac{K}{C_{OH}^3} = 0; \text{ therefore}$$

$C_{OH}^3 = K$

But from (5)

$C_{OH}^2 \times C_{Fe} = K$, so that

$C_{OH}^2 \; C_{Fe} = C_{OH}^3$ and, therefore,

$C_{Fe} = C_{OH}$

This means that the sum of the two ionic concentrations is a minimum when the ferrous-ion concentration equals the hydroxyl-ion concentration. For this reason the point P is called the equivalent point.

Equations (3) and (4) restated are:

$$E_1 = E_{Fe} + \frac{0.0591}{2} \log_{10} C_{Fe}$$

$$E_2 = E_{OH} - 0.0591 \log_{10} C_{OH}$$

At the protective potential point (equilibrium voltage) it has been shown that the two equations intersect and therefore their voltages are equal. Therefore:

$E_1 = E_2 = E_p$ = protective potential and, as shown, $C_{Fe} = C_{OH}$

Substituting Ep in equations (3) and (4), clearing, and adding

$2\,Ep = 2\,E_{Fe} + 0.0591 \log_{10} C_{Fe}$

$(+)\; Ep = E_{OH} - 0.0591 \log_{10} C_{OH}$

$3\,Ep = 2\,E_{Fe} + E_{OH}$

or

$$E_p = \frac{2E_{Fe} + E_{OH}}{3} \quad \ldots\ldots (7)^*$$

$E_{Fe} = -0.441$ and $E_{OH} = -0.8295$ both with reference to the normal hydrogen electrode at 25°C.**

Therefore,

$$E_p = \frac{2(-0.441) + 1(-0.8295)}{3}$$

$$= \frac{-0.882 - 0.8295}{3}$$

$= -0.5705$ at 25°C. with reference to the normal electrode.

This is the theoretical protective potential exclusive of IR drop through the soil and the liquid junction potentials of the solutions.

NOTE: Other values of Ep may be determined as follows: (1) Ep, referred to the solution of electrolyte = —0.2853. This value is one-half 0.5705, or the half-cell voltage to the solution. (2) Ep, referred to the copper sulphate solution = —0.8353, assuming a constant of —0.55 for the solution. [—0.55 + (—0.2853) = —0.8353]. (3) Ep, referred to the tenth-normal calomel electrode = —0.9039. This value is the sum of the solution potential of the calomel half-cell (—0.6186) plus —0.2853.

**These basic values may be obtained from any of a number of reliable chemical handbooks.

Repeating equation (1)

$$E = 0.000193 \frac{T}{v} \log_e \frac{P}{P'}$$

Assuming that the other factors will be a constant for any given set of conditions it is evident that:

$$\frac{E_1}{E_2} = \frac{T_1}{T_2}.$$

This means that the potential of an electrode is directly proportional to the absolute temperature and it likewise follows that $\frac{E_{p^1}}{E_{p^2}} = \frac{T_1}{T_2}$ expressed in terms of the protective potential at 25°C.

$E_{p^2} = -0.2853 - 0.00096\,(t-25)$ (8) when t is in deg. C.

Likewise

$E_{p^2} = -0.2853 - 0.00053\,(t-77)$ when t is in deg. F.

At less than the protective potential, metallic iron is taken from the solution and at greater than the protective potential, gaseous hydrogen is evolved. In both cases so long as the cathode *is* a cathode and maintains a negative potential, hydroxyl ions are liberated near the cathode. From Faraday's law it follows that the rate of hydrogen production at the cathode is directly proportional to the current density. The soil represents an infinitely large amount of "solution" so that no rapid change in composition can take place in it and many of the hydroxyl ions diffuse or leave the cathode. Those that remain neutralize the normal acidity of the soil, increasing its alkalinity and free hydroxyl-ion concentration. If the current supplied from the generator is kept constant then the cathodic potential will rise to a more or less constant value at which the rate of production and rate of removal of hydroxyl ions balance and the hydroxyl-ion concentration in the vicinity of the cathode assumes a constant value.

Summarizing properties of the protection point at the iron cathodic protective potential:

1. A sharp decrease of ferrous-ion concentration at the cathode to virtually zero because of its nearly complete deposition on the cathode as metallic iron.
2. A sharp increase of hydroxyl-ion concentration at the cathode.
3. Total ionic concentration reaches a minimum.
4. Decomposition of the water of solution into hydrogen begins.
5. At a higher potential than the protective potential little reduction of ferrous ion takes place, most of the energy going into the evolution of hydrogen.

(To be continued in an early issue)

"THE CHIEF" tells "SONNY" about his visit to the New York World's Fair

SONNY: Haven't seen you around the last few weeks, Chief. Where've you been?

CHIEF: Well, I'll tell you, Sonny. I been itchin' for a little vacation for some time. So a couple of weeks ago, I bundled Madge and the boys into the car and set out for the World's Fair in New York.

SONNY: Gosh, Chief, you must have had a wonderful time!

CHIEF: You bet I did. And would you believe it, the first thing I ran into was a rotary rig operating on a 200 foot derrick—right on the Fair grounds. And doin' business, too.

SONNY: Well I'll be jiggered! That sounds like the postman who took a walk on his vacation.

CHIEF: Yes, it does sound funny. I no sooner quit the derrick, and what do I run into but the Roebling Rope Exhibit in the Metals Building. Better still, who was there but Big Bill from The National Supply Company.

SONNY: I give up, Chief. It sounds like a fairy story to me.

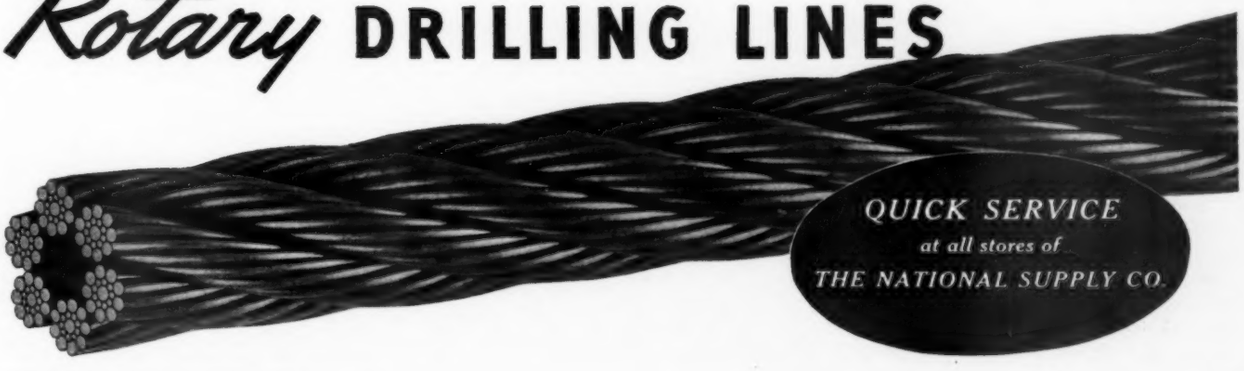
CHIEF: Well, Sonny, talking about fairy stories, I used to think Bill told a few every now and then, when he'd keep harping on the uniform high quality of Roebling's Blue Center Rotary Drilling Lines—and what they did at the plant to insure that high quality. But Bill yanks me out to the plant in Trenton, and I'll tell you, after seeing how those Roebling Boys make rotary drilling lines, I guess Bill was right after all.

SONNY: Don't tell me you fell for any selling talk, Chief?

CHIEF: Not at all, Sonny. This is something I saw with my own eyes. I'll tell you, it was mighty convincing to me, when I saw how carefully they make the rope steel in little open hearth furnaces; keep watching it as it bubbles away; adding a pinch of this and a pinch of that—how they keep checking this and checking that, all along the line, right up to the Shipping Department. And then the Research Laboratory, Sonny—one of the most modern in existence, I understand. When I saw their big testing machine tear a 4 inch rope apart, as if it were a piece of twine —well, Sonny, I voted it a day well spent!

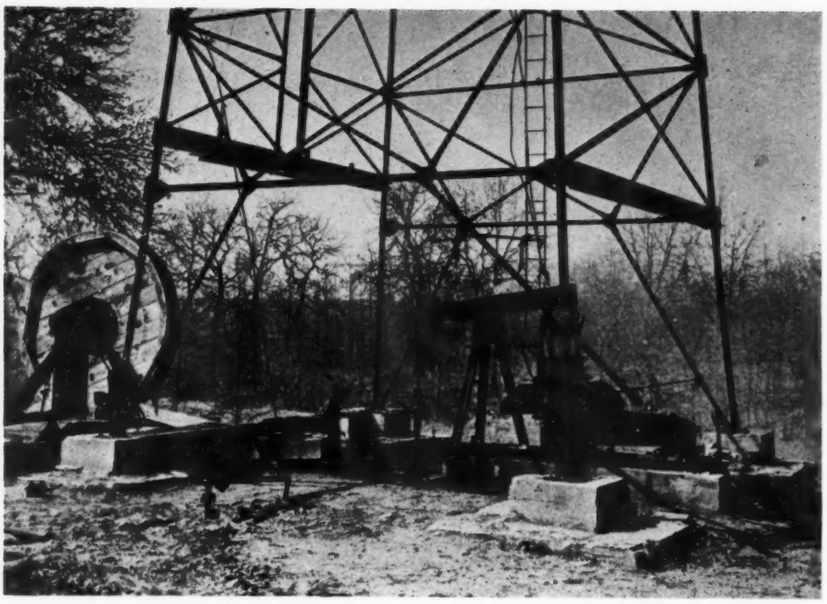
JOHN A. ROEBLING'S SONS COMPANY
TRENTON, N. J. *Branches in Principal Cities*

ROEBLING
Rotary DRILLING LINES



QUICK SERVICE
at all stores of
THE NATIONAL SUPPLY CO.

P 531.



A 3-hp. pumping unit replaces the old bandwheel equipment shown at the left in the illustration

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Lightweight Pumping Equipment Saves Small-Potential Wells From Abandonment

Older, heavier equipment had become uneconomical —pumping units powered by 3-hp. motors have extended productive life of wells now producing 3 to 10 bbl. per day

By W. H. STUEVE
Oklahoma Gas and Electric Company

A LARGE oil-producing company, operating in the Seminole field, Oklahoma, incurring an ever-increasing cost of producing oil from a large group of wells drilled in 1926 and 1927, was confronted by the problem of abandoning the wells unless some more inexpensive method of pumping could be employed.

The wells originally were fairly large producers but, because of the normal decline in potential in the 13-year period, the daily production had decreased to 3-10 bbl. per well.

In 1926 the wells were drilled to an average depth of 3340 ft., casing was set at 3200 ft., and a 1⅛-in. working barrel set at approximately 3300 ft. The wells were equipped with 2-in. tubing and ¾-in. rods. Single-cylinder, slow-speed, horizontal, 50-hp. gas engines were installed to drive the conventional assembly of bandwheel, wooden walking beam, and samson post. Prime movers of this size permitted relatively long strokes (48 to 60 in.) at the rate of 20 to 25 s.p.m. Well servicing (rod-and-tubing jobs) could also be powered by the engines installed. In recent years, however, well servicing by portable winches mounted on trucks has proved more advantageous and economical, so that the prime mover at the well is no longer used for that purpose. Wells that originally required about 25 hp. for steady pumping now require only 3 to 5 hp., as the length of stroke and s.p.m. were reduced because of the production decline. The amount of gas fuel per b.hp-hr. required by the engine increased sharply as the load was reduced. The adoption of repressuring as an economic means of increasing the ultimate recovery from the wells further made it imperative that gas be conserved, a large volume of which was being used as fuel in the engines.

The principal objectives desired by the operator, therefore, may be summarized as follows:

(a) reduce or eliminate the high maintenance cost of the old equipment,

(b) conserve the gas ordinarily used as engine fuel,

W. H. STUEVE

received both mechanical and electrical engineering degrees from Ohio State University—Is a member of the Oklahoma State Board of Registration for Professional Engineers—Member of the American Society of Mechanical Engineers and the American Petroleum Institute—For the last 15 years he has been associated with the Oklahoma Gas and Electric Company, having charge of oil-field, pipeline, and refinery electrification—Recently he had added to his duties that of manager of the Department of Industrial Development.

WHY

HAVE CONTROL DURING OPERATIONS

and

RUN THE RISK OF BLOWOUTS BETWEEN OPERATIONS

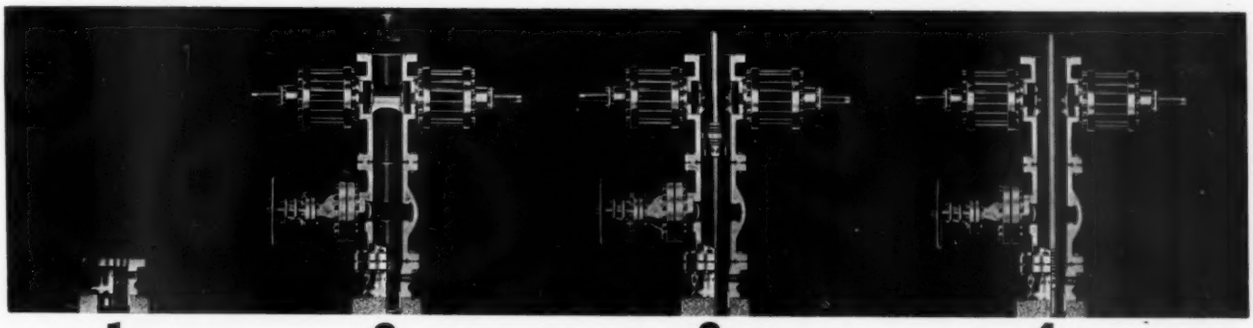
WHEN GRAY SYSTEMS OF WELL CONTROL GIVE YOU CONTROL

GRAY

SYSTEMS OF WELL CONTROL

during and BETWEEN

all operations from spudding to running the oil into the tanks

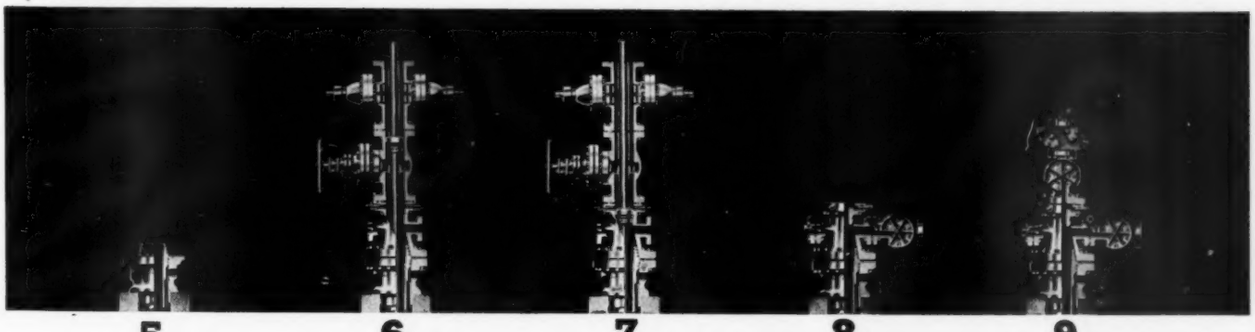


1 CASING HEAD ATTACHED WHILE CASING IS CEMENTED

2 DRILLING

3 RUNNING CASING

4 CASING LANDED AND CEMENTED



5 DRILLING CONTROL EQUIPMENT REMOVED WHILE CEMENT IS SETTING

6 DRILLING-IN AND RUNNING TUBING

7 TUBING LANDED

8 CONTROL EQUIPMENT REMOVED

9 MANIFOLD ATTACHED

See Gray Section Composite Catalog

GRAY

TOOL COMPANY

HOUSTON – TEXAS

See Gray Section Composite Catalog

(c) reduce the cost of labor required in operating the wells.

As a part of the latter objective, it was recognized that automatic starting and stopping of the well pumps would contribute materially to a reduction in the number of operators required.

After consideration of the various factors involved, small electric-powered pumping units were decided upon. The accompanying illustration shows a typical installation of a 3-hp. splash-proof electric motor and pumping unit that has been adopted as standard.

In the economic studies that were made, it was found that the small electric units would pay for themselves in about 14 months in the savings effected after consideration was given to all costs including the bill for purchased power, based on an average continuous operating time for each well of 4 months per year or, in effect, 8-hr. per day pumping.

The amount of oil recovered from the wells pumped by these small electric-driven units will average 75 percent of the total fluid produced, when the entire lease comprising 18 wells is considered.

Several of the newly-equipped wells were selected at random for further study to determine the overall efficiency from the electric input at the 440-volt service to the fluid delivered into the tanks. The results of two of tests are shown in Table I.

The results of tests on several wells disclose the overall mechanical efficiency is virtually the same in all cases.

TABLE I

Mechanical and Volumetric Efficiencies of Wells Pumped by 3-hp. Electric Units

Well	Depth, ft.	Diam. of working barrel, in.	Length of stroke, in.	Strokes per minute	Hours pumped per day	Barrels produced		Average electric input, kw.	Volumetric efficiency, percent	Mechanical efficiency, percent
						Water	Oil			
A	3215	1⅜	18	14	12	1	4	1.05	28	15.4
B	3310	1½	18	14	6	1	2	1.36	18	15.5

The depth at which the pump is set, as in wells A and B, in Table I, is almost the same; also the s.p.m. and the stroke length are identical in each case. The volumetric efficiency of well B, no doubt, could be improved if a smaller working barrel were installed, which would also tend to reduce the power input slightly.

The overall efficiency of both wells, A and B, is somewhat lower than is ordinarily expected of beam-pumping equipment, which usually averages 30 to 35 percent for larger installations. If the pumping time could be reduced to about one-half of that shown, and the expected production could still be obtained, then, no doubt, the mechanical efficiencies would tend to be more in line with average results in larger wells pumped on the beam.

Special electrical tests were conducted using power-curve recording instruments to study the loading conditions on the motors used for pumping. The motor manufacturer supplied information regarding efficiencies and power factor at ¼-, ½-, ¾-, and full-rated shaft load for the high-resistance rotor-type motors used. These motors operate at 855 r.p.m.

In well B, the average load was 1.36 kw. or 1.82 hp. and the mechanical efficiency of the motor is 80 percent from ½-load to full-load. Thus, 1.46 hp. of the electric input goes to effective work.

At ½ shaft-load on the motor the instruments recorded an average of 50 percent power factor, a value that is in line with the manufacturer's data.

The pumping costs for the two electrified wells detailed in Table I range from 4½ to 6 cents per bbl. of oil produced, when labor and maintenance are not considered.

At the present time 23 additional installations are contemplated, and the transition from the existing equipment to the small electric equipment will be gradual. The results are being carefully studied and, as time goes on, the savings being made by one producer may induce other producers in the Seminole area to adopt similar programs.

Slump in Barite Sales Offset By Use in Oil-Well Drilling in 1938

AN increase in demand by the petroleum industry for deep-well drilling cushioned the slump in the barite industry in 1938. U. S. Bureau of Mines figures show heavy declines in consumption of barite for making lithopone and barium chemicals, yet production in the United States declined only 7 percent and sales 13 percent from the 1937 totals. Shipments of crude barite from domestic mines in 1938 were 309,663 short tons valued at $2,004,521 compared with 355,888 tons valued at $2,240,970 (revised figures) in 1937. Imports of crude barite in 1938, however, were less than half those of 1937, 24,845 short tons compared with 64,992 tons in the preceding year. The apparent new supply was only 334,508 short tons compared with 420,880 tons in 1937, domestic mines supplying 92.6 percent in 1938 instead of 84.6 percent as in 1937.

Skyrocketing to an all-time record of 186,607 short tons, the quantity of crude barite used in the production of ground barite continued its upward trend and exceeded for the first time since 1916 the quantity used in the production of lithopone. Seventy-nine percent of the ground barite produced, or 126,697 short tons, was consumed in drilling oil wells. No other use took more than 5 percent of the total sales of the ground product. The quantity of crude barite consumed in lithopone production was less than in any year since 1922, and the consumption in barium chemicals declined sharply. Although total sales of barium products were only slightly less in 1938 than in 1937, the value declined by more than $2,000,000 due principally to the relatively small sales of lithopone and blanc fixe. In the barium chemicals group only the dioxide and hydroxide showed increases.

Barite was mined in 1938 in nine states—Arizona, California, Georgia, Missouri, Nevada, South Carolina, Tennessee, Texas, and Virginia. Sales were reported in all but Virginia, where production went into stock. Missouri as usual was the leading producer and Georgia was second. Decreases were reported by each of these leaders in 1938. The average value per ton of domestic sales as reported by producers to the Bureau of Mines increased to $6.47 per ton in 1938, continuing the advance from the 1933 low. Quotations for ground barite were unchanged in 1938 compared with 1937. Although precipitated carbonate prices also were unchanged, those for ground witherite were slightly lower as were those for lithopone and barium nitrate. Barium chloride quotations moved in a narrower range.

This Industry of Ours

AN INSIDE LOOK AT THE OIL INDUSTRY AND THE LOT OF THOSE WHO SERVE IT

By NORTH BIGBEE

Part 2

Petroleum, a fertile field of opportunity for ambitious employee —vocational training courses and safety instruction improve his general working conditions

JIM BROWN was like a lot of young fellows who finished high school around 1920.

Times had been getting harder. The post-war boom was playing out. Prices were up and money was scarce.

But to Jim, on that sultry June night in his blue serge suit, all that seemed pretty far away as he proudly walked across the stage to receive his diploma in the stuffy little high school auditorium.

It was not until he set out the next day to find a job in the small town where he lived that he realized getting work took more than merely asking for it. Nobody seemed to have a place for an ambitious young fellow who was trying to make enough that summer to enter Texas University. During the next few months he picked up what odd jobs he found and added every cent he could to his meager savings in the town bank.

He didn't have much when September came, but he went to Austin anyway. Maybe he could get work after classes. But he wasn't able to do anything in particular, and good boys come cheap in Austin. It was only with the help of his family (who by now were having trouble themselves making ends meet) that he finished his first year at the university.

Jim had already decided before he started back home that he would stay out of school a year and help his Dad if necessary. Work was still scarce in their town, but there was a natural gasoline plant being built nearby and Jim landed a job on the labor gang at 30 cents an hour. When September came, his family still needed his help; so he stayed on.

This is the second of a series of four articles on the oil industry and its employees. Next month's article will answer the question, "Why work for an oil company?"

Jim never got back to college. Within a few months, the foreman of the gang got a promotion, and Jim was made gang foreman. He was proud to be getting ahead. But as time went on, he got no further whereas others who had come with the company since he had were moving past him.

At first Jim was inclined to blame his bosses for playing favorites. Finally, though, he admitted to himself that maybe it was his own fault after all. He didn't know anything but the work he was doing. There wasn't any job they could advance him to if they'd wanted to. So he decided to learn some definite phase of the industry so he could be promoted.

In high school he'd enjoyed chemistry a lot. He'd like to be a chemist at one of the gasoline plants. But how? College was beyond his reach. There didn't seem any way.

One day he got to talking with the chemist at the plant, and before he knew it, he'd told him all his troubles. The chemist was interested. He volunteered to help Jim himself and to get the company to help. In a few days, Jim had a letter from the home office offering to repay the full cost of a home-study course in industrial chemistry if Jim completed it in the time the school set. Jim ordered the course by the next mail.

It wasn't easy. Jim had to work all day in the heat or the cold and then bone away late into the night solving problems that were hard at best. But he stuck with it, and finally finished it.

Promotion

The results weren't long in coming. A small gasoline plant was completed soon afterward and a chemist was needed. Jim's chemist friend recommended him highly, and the home office knew about him from his record on the correspondence course. Jim got the job!

He was very proud of the place he had won, and very happy in his new work. He even got married on the new salary he was earning.

But maybe he figured he had learned all he needed to, and that he was entitled to take a rest. Anyhow, he stopped studying and contented him-

self with doing no more than he had to do.

In a short time the superintendent of the small plant was promoted to a larger one. Jim thought the job was rightfully his. But this being a true story, instead of a Horatio Alger yarn, Jim didn't get the job. They passed over him and brought in a man with more executive training. In a little while the superintendent was transferred, and this time Jim thought for sure he'd get the job. He was passed over again for another young fellow who had made a record in managing men at another plant.

So Jim decided maybe he had better study some more. With the coöperation of his company again, he enrolled for another home-study course, in modern foremanship. It took a lot of plugging away when Jim might have been enjoying himself, but he finally finished it. Then not long afterward another change was made in the superintendency of the small plant. This time it was Jim who got the job!

This time, also, Jim didn't rest on his oars. He set out to make a record for his plant and to make more friends for his company in his home community. The result was that when the superintendency of one of the company's largest plants was offered him later, the various civic boards and community clubs and church organizations in which Jim had become a leader petitioned his company not to take him away from them.

But Jim had to move on and up. Today, a little short of forty and earning an excellent salary, he is district superintendent for one of his company's larger districts. He's a member of the school board and Y. M. C. A. board, a director of the Chamber of Commerce, past president of the Rotary Club, and active in his church and many other groups for the betterment of the small city in which he lives. In more ways than one, Jim is a success.

George Does It

Jim's case isn't typical. He had a year of college training and a knack for making friends. Suppose we take George Smith, who never got through high school.

George had a gift for rubbing people the wrong way. It had kept him from making many friends in childhood, and it seemed to get worse as he went through school. This threw him more and more on his own resources, and he used to spend hours in the little shop he had rigged up in his backyard. This made him a pretty good mechanic, even though it made him no friends. So George finally decided to quit school and go to work where his skill might help him out. But it looked as if he might never have a chance to display his ability. He was started in the labor gang at a large plant at 30 cents an hour, and there he stayed.

After many months in the same work, George finally decided the only way he could show what he could do was to learn how to get along with other people. So, with the financial aid of his company, he enrolled for a home-study course in modern foremanship.

One course wasn't enough for George. He showed some improvement in his relations with the other men, but he still had a lot of rough edges. So he enrolled for a second correspondence course, in modern plant management. This helped some more. Gradually he got himself out of his old ways and began learning how to manage men. As he improved himself, his jobs got better and better.

To make a true story also short, not so many years later George returned as superintendent to the same large plant where he had started as a laborer! Today he is district chief engineer for his company—and throughout the company he is known for his exceptional ability at getting along with people.

Both Jim and George got theirs the hard way. They had to dig out what they needed, for themselves. There were no special courses then for the worker in the oil industry who wanted to know more about his job, or the job ahead. The only courses they could find came by mail.

School a la Carte

Today all that is changed.

Instead of the employee having to write for a correspondence course, the course now comes to the worker. It is as near as the refinery in which he is employed or the toolhouse on the lease where he is drilling, or the pumping station where he works. Instead of having to study a general course in which he wastes half of his time, the employee is offered specialized instruction prepared by practical drillers or production men or refiners on the very subject he wants to study. Instead of a man at a distant desk in the East correcting the papers he has sent in, there's an expert driller or graduate engineer a few feet away to answer his questions and point out what he wants to know, right on the rig or in the plant or pump station.

All this has happened in the last few years.

The real beginning was in 1917 when Congress passed the Smith-Hughes Act providing, in part, for the Federal Government to extend financial aid to the States that wished to organize vocational training programs for adults employed in industrial mechanical trades. The courses taught must be applicable to the work of the members; that is, it would be possible to organize a class of oil-field workers in production practices, but not, say, in air conditioning. The subject must relate to their current jobs, or some phase of the industry in which they work.

The instruction must be of less than college grade and suitable for individuals over 16 years of age. The work must be a joint activity of the Federal and State governments and the local public school authorities in each community. Supervision was placed under the trade or industrial training department directors of each state, who would organize the work, and provide instructional material and instructors. The primary purpose of the instruction was to enable individuals already employed to add to their special knowledge and skill pertaining to their work if they wished to, and thereby improve their prospects for steady employment, or to prepare themselves for promotion. All courses are entirely voluntary.

The Good Old Days

At the time the act was passed, the oil industry was quite different from what it is today.

Men then worked a 12-hour day in the oil fields. A single lease would often have wells in every stage of development, some drilling, others flowing, a few swabbing, some pumping, and perhaps a cable-tool clean-out job or fishing job. It was an every-day occurrence to see rig builders, tank crews, teaming contractors, and pipeline crews at their work. Each field was, or soon became, an example of almost every type of oil-field drilling and production activity.

This made it easy for any worker with sufficient energy to walk to the adjoining lease to learn what the worker on the other job was doing. Any normally industrious pumper, roustabout, or gauger, after working a few years in such a field, could consider himself an experienced oil-field worker because he would have picked up enough to do most of the work required. Both the employee and the employer expected the worker to learn his trade while working.

Specialization

As oil-field activities became more specialized, all this changed. Shorter hours left the worker little time dur-

ing the working period for anything but his own particular job. Older and slower drilling methods gave way to the fast rotary. A man on a rig did nothing but drill. A pumper might never see anything but the wells that he pumped. A pipe-line worker didn't look to the right or left of his line.

Relatively simple equipment gave way to complicated improvements. New drilling problems were solved with new drilling methods. New ways of prospecting and of well completion became general. New processes were introduced in refining. Natural gasoline manufacture became an important division of the oil business. The worker who depended upon picking up his knowledge by casual contact was likely to find himself left behind by the man who had given intensive study to these improvements.

At first, some of the oil companies shouldered the responsibility of providing opportunity for the employee to keep posted. Excellent as were some of the courses offered, this was an individual and uncoördinated effort that reached only a small percentage of those who wanted additional training. The importance of these companies' work, however, in showing the need for and great value of these courses cannot be overestimated.

For many years some of the companies had conducted schools to train their personnel in the sale of company products. In a few of the larger cities, night schools had offered courses of general application to the petroleum industry, and a few enterprising foremen and superintendents had conducted special classes for their workers.

It was not until 1926, however, that the first vocational evening classes in the petroleum industry in the southwest were offered to employees. This was by Marland Oil Company (now the Continental Oil Company) through its educational affiliate, the Marland Institute. Although short-lived, the work done by the institute was most helpful toward the promotion of an industry-wide program of opportunity for the petroleum worker.

In Texas the first classes were offered by the Humble Oil and Refining Company to its employees at the Baytown refinery. This was in 1929, when such courses as blue-print reading, welding, pipe fitting, and mathematics were given to a large number of interested employees. The Humble is still a leader in vocational training, carrying on many courses of its own yet, as well as coöperating closely with the state training program.

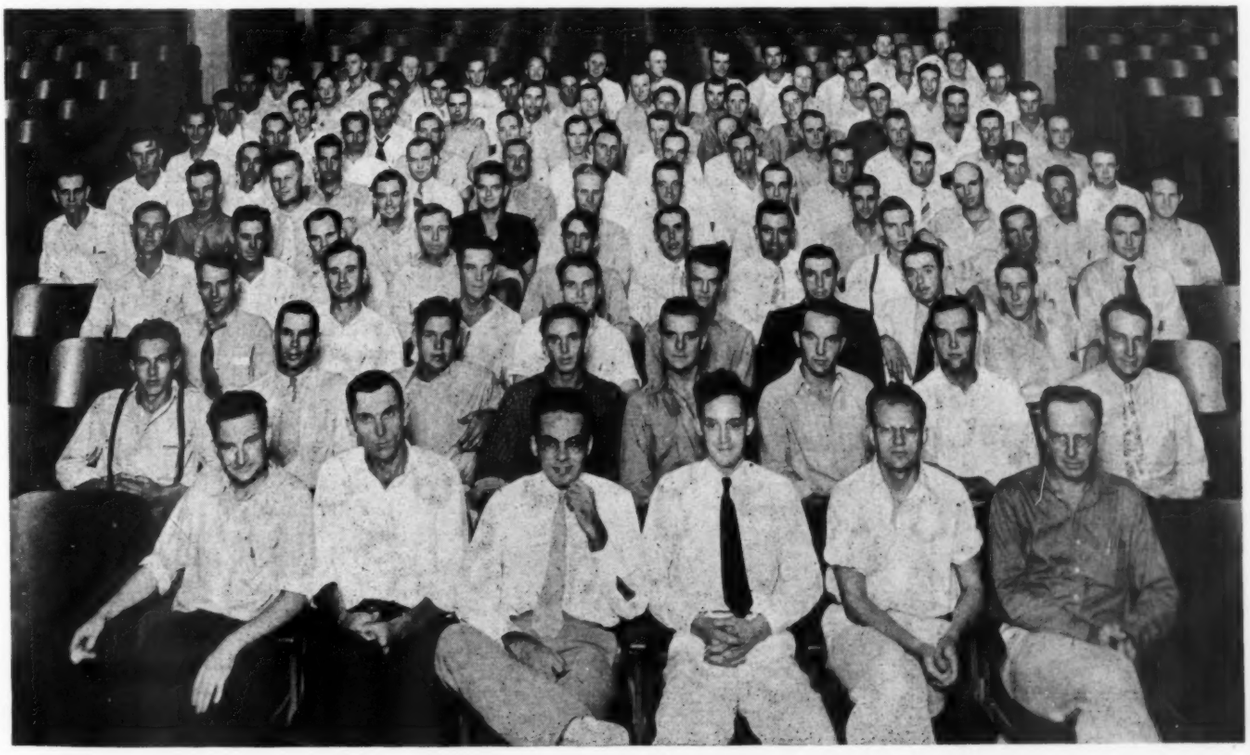
Recognizing the need for a general and organized program of vocational education in the petroleum industry, the safety directors of some of the larger Mid-Continent companies, during the various foreman conferences inquired of the State vocational supervisors if such a system could be offered through their organization. As a result of these inquiries, the state supervisors felt that interest was sufficient to warrant an educational program exclusively for the oil and gas industry.

So, in April, 1933, they solicited the coöperation of the American Petroleum Institute, long known for its success in standardizing equipment and other difficult technical jobs. At a meeting in Dallas with safety and educational leaders of the industry, it was decided that the following should be undertaken:

1. Development of a course explanatory and descriptive of the industry.
2. Development of specific courses applicable to the various kinds of work in the industry.
3. Provision for an agency within the industry to assist in carrying on the work.

As a result of this meeting the Texas and Oklahoma supervisors of vocational education were invited to appear at the 1933 Mid-year Meeting of the American Petroleum Institute

A vocational training class held in conjunction with the Texas State Department of Vocational Education. Groups of this size are the rule rather than the exception, attesting to the popularity of special training



in Tulsa, to explain their part in the promotion of such a program. At the annual meeting of the Institute in Chicago in the fall of 1933, the A. P. I. central committee on district activities decided to appoint a topical committee on vocational education to act as a correlating and validating committee on instructional material.

This committee soon began to function. Already having an example of what could be done through the cooperation of practical oilmen in Pennsylvania, where Pennsylvania State College, in 1931 (with the oilmen's assistance) had drawn up courses suited to the Appalachian fields, the Mid-Continent group set to work.

Several questions immediately presented themselves.

One was whether to prepare outlines on various subjects for the guidance of the instructors, leaving to them most of the responsibility for filling these in. This placed the burden almost entirely on the experience and ability of the individual instructor and could result in various interpretations of methods and principles.

Plan Adopted

Another problem was how to arrive at the courses most likely to be demanded by the workers. To determine this, an effort was made to analyze petroleum employment by jobs through use of company payrolls. The committee soon found itself lost in a mass of figures. At the suggestion of a committee leader, the group finally substituted the simpler plan of elementary, general, and specific courses, designed to interest large groups of employees regardless of what specific job they held. This had been suggested in part by the Pennsylvania plan. Also adapted from the Pennsylvania plan was the substitution of complete textbooks containing fundamental information on methods and equipment, for the proposed skeleton outlines.

As the system was finally worked out and is now functioning, the committee prepares and has practical operators approve an outline of subjects on which textbooks should be prepared. These subjects are assigned to the state vocational representatives for development and writing of the texts in order to eliminate duplication of effort. The committee assists in suggesting practical operating men to assist the state vocational representatives in preparing the books so they will have practical application to the petroleum industry. The committee members then go over, word by word, the books written around their outlines, thoroughly reviewing this material before validating it for publication and distribution. Even after the books are published, they are constantly being revised due to certain sections being made obsolete by the rapid progress of the oil industry.

Today with 15 texts already written by experienced textbook authors under supervision and criticism of experts in each department of operations, the search for more helpful material still goes on. One of the texts was completely rewritten three times before it finally met the approval of the critical oilmen.

Enrollment Large

So practical and helpful have been the courses worked out that in the first six years of their operation approximately 25,000 oil workers of eight leading oil states have been enrolled. In Texas alone, enrollment for all classes including refinery courses (as well as those in oil and gas drilling and production, natural gasoline, and pipe lines worked out by the A. P. I. Division of Production), totaled 13,631 from 1933 to 1939. In seven leading oil states, courses given numbered 754, held in 174 oil centers close to the men who wanted them.

The state directors of the training and the instructors are eager to tell stories about the interest shown by the men in the classes.

L. K. Covelle, director of vocational education for Oklahoma, recalls that one man drove 46 miles two nights a week for 12 weeks in order to take a course in elementary science. So pleased was he with the first one that he enrolled for another course the next year.

W. Fred Heisler, director of the School of Technical Training of Oklahoma Agricultural and Mechanical College and author of many of the oil instructional books, tells of a worker in a natural gasoline plant who drove 22 miles each class night for a course in arithmetic. The next year he organized his own class in his camp, and had the teacher drive the 22 miles. Transferred later to another state, the resourceful student kept up his studies in the classes there. Now he is back at his first location, employed as assistant superintendent of the same gasoline plant where he had been a laborer.

So popular did the evening classes become in Lost Springs, Texas, that the proprietors of a pool hall and a drug store closed their places of business and enrolled in the classes themselves. Everyone else was going to school, and they had no business the nights the classes met.

In the famous little Oklahoma oiltown of Bowlegs, enthusiasm reached such a high peak that the wives of the men organized a class that met at the same time but at a different place, to study the same subjects as their husbands did. Incidentally, there was a strong suspicion that the wives worked most of the problems for the men.

To the oil employee having a good education, the importance of the

Modern refinery practice is being studied by this group

courses to his less fortunate associate is sometimes hard to realize.

For instance, one middle-aged man who had never learned to read or write, took one of the elementary courses. So proud was he of learning to write his own name that he practiced by writing it with a piece of chalk all over the walls of his garage.

In another class, a group of men who had been studying the addition of three-digit numbers were given a written quiz. A man with many years of oil experience, 57 years old and almost white-haired, made 100 on this test. He was so proud of his accomplishment that he stood up to express his appreciation for the instruction he'd been given. Tears came to his eyes, however, and his voice choked so that he was unable to speak. He stood for a moment in silence and then sat down.

Seeking Opportunity

It is easy to find examples of how the instruction has helped some oil worker to do his job better or to move on to a better job. But no promises are made the employee by any of those preparing or sponsoring the courses that anything will come out of them save the worker's satisfaction at knowing better what his job is and what it means in the present complex organization of the oil industry.

As the chairman of the committee that prepared most of the courses, explained in a recent talk on vocational training for the oil worker: "This is not a dissertation on how to achieve success in ten lessons or even that many subjects. . . . Vocational training courses are not intended to be a substitute for the curricula of grade or high schools nor are they intended to be college or liberal in scope. . . .

"Almost every normal person has a desire to progress, to better his station in life, to achieve success in business, to be more than just another worker. Of course it is impossible for all of us to become foremen, general superintendents, or vice-presidents because there must be someone left to do the work.

"But through systematic study we all can learn more about our particular occupation and those occupations allied or related to it. This broadening of one's vocational education not only better fits the individual to perform his job, but if the opportunity to advance presents itself, he stands the better chance for promotion than the man who has not taken advantage of increasing his vocational knowledge . . .

"Any man who has been employed in the petroleum industry for the past ten years can attest to the fact that vast changes have taken place in all branches. New methods have been adopted and the technique of their application has greatly improved. Standards of workmanship have been raised and the individual worker finds it requires study and earnest application of his talents not only to keep pace with progress, but also to better himself.

Price of Leadership

A leading educator recently made the observation that, "Educationally, we have succeeded only when students learn to do better the things which they are going to do anyway."

Commenting on this, John A. Ritter, a member of the A. P. I. Topical Committee, in presenting certificates of achievement to a number of New Mexico oil workers who had completed courses, emphasized, "A large majority of you have attended these classes to improve your work and because, as normal Americans, you desire to achieve some success in business life. I believe that learning more about your particular occupation is the very best way for you to keep ahead of your job and compete with those around you who are also seeking advancement.

"The price of advancement is hard, driving, continual work. Only a few are willing to toil through the night while their fellow-workers are taking their ease, and most of us do not choose to make the sacrifices which must be made by those who aspire to become leaders. Those of you who receive certificates have labored to extend your mental frontiers. You should derive a great personal satisfaction from accomplishing what you set out to do. I hope each of you will continue this struggle until you reach your particular goal."

The Men Speak

That the employees themselves are fully aware of the importance of the courses and welcome the opportunity to take them is shown by a number of incidents.

One of the stories is told of a meeting in a toolhouse of one oil company. The chairman called upon the educational advisor for an explanation of the program. The advisor explained briefly to the men how it affected them and how it would increase their efficiency and industrial knowledge. So enthusiastic were they when he got through that a motion was made by one of the workmen that every man present enroll for classes. The motion was seconded and every man signed up.

In another company, announcement was made of a district course in elementary science. Out of the approximately 300 men in the district, 150 signed up immediately. But when these men received their textbooks and began talking about the course to the other men, 103 more men enrolled, a total of 253 out of 300. The men kept up the enthusiasm with which

Every phase of the petroleum industry is a subject for study. This class in vocational training studies pump design

they had started the course, and attendance during its duration averaged 90 percent.

In an Oklahoma refinery, a young oil worker employed as an instrument repairman was taking unusual advantage of the evening school offerings for employees of his plant. In fact, he attended classes four evenings a week. Finally he enrolled for another class that took up a fifth evening.

A friend asked him how his wife liked his being out almost every night.

The repairman grinned sheepishly.

"She used to say plenty when I was gone four evenings a week," he admitted. "But then I found a course in home landscaping for the fifth night, and took my wife with me. Now she thinks all the classes are swell."

Incidentally, after three years of evening school work, he was promoted to be instrument foreman.

A group of young welders were discussing taking a course in mathematics offered in the coöperative oil educational program. When the supervisor was asked what the cost was, he explained, "It will be $1.50 for each six weeks for as long as it takes."

One prospective student laughed and told him, "I may just as well pay you $50 right now."

In 12 weeks, however, he had won promotion to a job requiring the very mathematics he had been studying.

Courses Offered

Today for the expenditure of $1 to $3 enrollment fee (tuition is free) and 20 cents to $1.50 for textbooks, an oil employee can get detailed and expert instruction in almost any phase of oil and gas operations that he desires. California and Kansas make no charge; and some of the companies even refund part of these costs in the other states when the employee completes his course.

Already 15 different textbooks totaling nearly 2000 pages have been completed by practical oilmen in cooperation with leading vocational educators to offer the oil worker a wide variety of courses.

If the employee had to quit school early, or has forgotten his early schooling, he can take basic courses.

These basic courses are understandable to workers having only a seventh-grade formal education.

General courses offered in this cooperative program deal with operations and maintenance common to the entire petroleum industry. They are more technical and the textbooks are profusely illustrated with pictures and sketches of the equipment actually used in the industry.

The instructors most successful in teaching these courses have been those who took their classes into the workshops and engine rooms and had the men actually perform the operations that they were studying. For instance, internal combustion engines were completely dismantled and reassembled. One and sometimes two lessons were devoted to such subjects as lubrication, ignition, ring wear, etc.

Supplementing these general courses, the state vocational education heads in coöperation with the A. P. I. Topical Committee of the Division of Production have drawn up special courses designed expressly for specific groups of production employees.

Approximately 9000 copies of the books have been sold, and they are now being used in India, Russia, England, Peru, Austria, and Arabia, as well as the United States.

Although these are the only courses in which complete instructional material has been prepared by the state education officers in collaboration with the A. P. I. Division of Production, some of the states offer various other oil courses. These have the same requirements for organization; that is, that at least ten employees must enroll for the course and that a local instructor having practical experience in the subject, who shall be approved by the state vocational educational department, shall have charge.

In most of these courses the conference method is a favorite type of holding a class. That is, the instructor presents a problem to the men and out of their collective experience they solve it. This type of instruction has been particularly successful when text material is not available or merely in outline form.

Special Courses

Texas offers the oil worker such additional courses as: Story of Petroleum, Geology, Combustion, Pulling Wells, Cementing and Plugging, Water Treatment, Emulsions, Paraffin Problems, Shooting, Acid Treatment, Reservoir Repressuring and Pressure Maintenance, Lease Storage, Oil and Gas Separation, Evaluation of Petroleum Products, Pipefitting, Foundations, Oil Field Cleanliness, Construction and Operation of Camps, Report Writing and Record Keeping, Sheet Metal Work, Instrument Reading, Lubrication, Mechanical Drives, Lease Pipe Lines, Power Plant Operation, Leases and Titles, Welding, Properties of Gasoline, T-Square for Rig Carpenters, General Refinery Processes, Cracking Coil Operation, Solvent Treating, Sampling and Physical Testing, Analytical Testing, Polymerization, Crude Distillation, Cracking, Gasoline Plant Operation, Treating Methods, and First Aid.

Finding instructors for these classes has been a problem. Persons actually employed in the petroleum business are given preference, local school teachers who have had recent practical experience in the oil industry being given the next call. For shop courses, at least seven years' experience in the trade in addition to a high school education or the equivalent is expected of the instructor. In theory, laboratory or related subjects, instructors are expected to have had four years' technical training in a first class school of engineering plus at least a year of practical working experience, or to have had two years of technical training and two years of trade experience. The instructors must be issued vocational certificates by the state head of vocational training.

Oklahoma has been active in the training of instructors to handle the oil courses, and in this respect some of the other states have coöperated. A week's course of intensive instruction for men of engineering training and oil experience to acquaint them with teaching technique is held annually at the Oklahoma Agricultural and Mechanical College, at Stillwater. In Texas, the important teacher-training work is carried on under the University of Texas' extension division of teacher training, headed by Charles Cyrus. Mr. Cyrus' program includes field visitations.

Except for the state's own courses in refinery practices and some of the companies' special courses for their own employees, not so much has been done in educational work for the refinery workers. This has been due in no small measure to the numerous technical problems of handling such courses save at one of the larger and more modern refineries, where the company itself might have its own instruction for its own employees.

The division of refining of the American Petroleum Institute, however, has recently appointed a committee on vocational training in refining with Walter Miller of the Continental Oil Company at Ponca City, Oklahoma, as chairman. The committee is now outlining a program of instruction for refinery employees that should show results during 1940.

Taking the lead in the state sponsored courses for the refinery worker have been Texas, Oklahoma, and California. That there is a demand for such courses is shown by the enrollment in Texas. Virtually all the increase in total enrollment in oil courses in 1937-38, first year refinery courses were offered, was due to oil

workers who enrolled for the refinery instruction.

Awards

As evidence of the completion of the various courses, a certificate is awarded by the state boards of vocational education to each student completing one of the courses satisfactorily. These certificates are usually distributed by the class instructor, or will, when requested, be sent to the ranking executive of the department in which the student is employed or to the personnel supervisor of his company. The state board usually sends the name of each student completing a course to his superintendent or other company official in order that the employee may get proper credit. Many companies enter these upon the employee's service card where his accomplishment is a matter of permanent record.

To the student who completes a specified number of courses, a large Certificate of Attainment suitable for framing is awarded by the state board of industrial education of the state where he completed most of his work.

Requirements for such a certificate are:

1. The student shall have completed at least two approved basic courses, totaling not less than 90 hours in length.

2. The student shall have completed two or more approved general courses, totaling not less than 90 hours in length.

3. The student shall have completed at least 180 hours of approved special courses. General courses not used for credit in meeting requirement No. 2 will be accepted in partial fulfillment of this requirement.

Such certificates, which represent a tremendous amount of effort on the part of the student as well as a wide practical education in the oil business, are usually awarded at special "commencement" exercises with a leading official of an oil company making the speech of presentation. The certificates bear the state seal, show the name of the courses studied, and are signed by the head of the state board for vocational education as well as by the head of the local school making the award.

Pennsylvania First

To Pennsylvania, the pioneer oil state, must also go the credit for pioneering state vocational training for petroleum industry workers. For it was the commonwealth where Colonel Drake "poor-boyed" the original wildcat that first offered the oil worker a chance to learn more about his job and his industry.

Employees in the role of students receiving instruction in mathematics applicable to everyday operating problems in the oil industry

It was in 1931 that the Pennsylvania State College, long active in petroleum research, decided to enlarge its service to the oil industry by establishing a Division of Mineral Industries Extension. Both correspondence courses and extension classes were offered, the latter including instruction in ceramics, coal mining, ferrous metallurgy, petroleum production, petroleum refining, and natural gas engineering.

Still in process of development, the entire extension program has the counsel and expert assistance of advisory boards composed of leaders in the various mineral industries of Pennsylvania. Although instructional material has not been prepared in all the mineral industries, special attention paid to petroleum production and refining and natural gas has resulted in the development of three standardized three-year courses, one in each field. These were prepared and approved in coöperation with representatives of producers in the Eastern fields.

A textbook for each year of the courses has been prepared by the member of the Mineral Industries Extension staff who is responsible for that given subject. Members of the staff are aided in this work by the resident teaching staff of the Pennsylvania school in that particular field.

Recognizing the rapid strides being made by the oil industry, the writers of the material keep them up-to-date by constant revision and improvement. The books are published in uniform 6 by 9 size by the Pennsylvania State College.

The extension division offers a three-year course in petroleum production. Designed for the man who has had no opportunity to attend schools of higher education, the course consists of: I. First year—General preparatory course, using the same text as in ceramics, petroleum refining, and natural gas engineering. II. Second year—Practical geology, prospecting, mapping, and drilling methods now in use. III. Third year—Advanced geological information, current methods of water-flooding and gas-repressuring, oil-field engineering practices, tables for oil-field calculations, etc.

The natural gas engineering course includes the same material as petroleum production, for the first two years. In the third year, the course takes up detailed geological information of the Appalachian area, metering and regulation, tables for orifice meter calculation, and regulation problems.

Petroleum refining is also a three-year course, offering specialized material in this subject after the first year's general study.

Use of this standardized instructional material is required of all extension students desiring credit from the Division of Mineral Industries Extension. Credit for completion of each year's work with satisfactory coverage of the material for that year, en-

titles a student to eight points toward an industrial diploma.

Upon completion of the three volumes of the course selected (customarily done in three years of attendance at the extension classes held in the field or at refineries) the student is awarded a diploma in the subject he has studied. Although the certificate carries no college credit (being an industrial diploma) it is effective testimony to any employer that the man holding it has completed satisfactorily a prescribed course of study mapped out by experts for the occupation in which he is engaged.

Better Training Required

The state that first produced oil in commercial quantities has shown a surprising increase in production from 9,000,000 bbl. in 1929 to 19,000,000 bbl. in 1937. Most of the gain is attributed to the application of improved production methods discovered by research in coöperation with the laboratories of the Pennsylvania State College. At present responsible for 5.2 percent of the total oil production of the United States, Pennsylvania has managed to regain a larger share of the market by such improved practices as water-flooding, gas-repressuring, and other secondary-recovery methods. Maintaining this favorable percentage demands the continued application of the new methods, and this in turn necessitates workmen properly informed and trained in their use.

Deeper wells throughout the fields of the Appalachian area also demand changed methods from the industry's workers. With tests now going down 5000 to 7000 ft. or more in the search for deeper producing formations, the cable tools that have been standard in Eastern fields since Colonel Drake's primitive rig in 1859, must be replaced by the rotary. The eastern oil industry is requiring more highly trained workmen in order that the modern methods and the newest scientific discoveries may be put into practice.

Just recently Pennsylvania has allied itself voluntarily with the coöperative oil educational program by requesting the A. P. I. committee to check and validate the material in use in that state. This now makes all eight of the leading oil states coöperating in using material prepared or validated with the assistance of the A. P. I.

California Plan

Entirely different from Pennsylvania and also from the Mid-Continent oil states in its material and courses (though still coöperating with the A. P. I.) is California, second of the oil states in point of total production.

Due to unusual conditions in some of the California fields, it was necessary that the industry there develop early new methods and more advanced equipment, which the Mid-Continent and Gulf Coast later adopted for the harder and deeper drilling now common in these areas. The California industry also required trained men familiar with these methods.

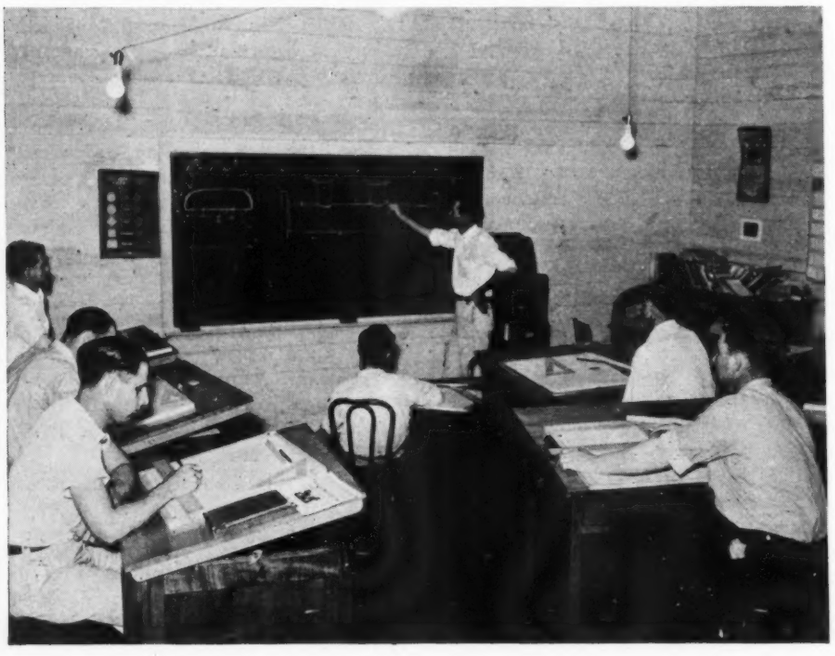
For some years the Bureau of Trade and Industrial Education of California and members of its staff have been coöperating with the state's petroleum industry in maintaining training programs for oil workers. A few years ago in discussing with American Petroleum Institute members the California Plan for Trade and Industrial Education and its provisions for state advisory committees to assist it in developing state-wide programs in specific fields and occupations, the chief of the bureau requested that a petroleum advisory board be established. The California District Committee on Vocational Training of the Division of Production of the American Petroleum Institute accordingly was appointed to serve as the state advisory committee for the production division of the petroleum industry.

Through the coöperation of this committee, a program of courses open to employees in the California industry was formulated, and outlines of 35 courses have been prepared by an engineer of the bureau engaged for this purpose. The bureau coöperates with employees and employers in the oil industry and with the local public schools in offering the extension courses. Enrollment in 1938-39, first year the new courses were offered, was 1679 in 34 classes.

The courses are offered under five headings, requiring various numbers of sessions to complete, as follows:

I. Drilling methods and problems:
   1. Petroleum geology, 6 sessions.
   2. Lease layout, 4 sessions.
   3. Construction and rigging-up, 6 sessions.
   4. Rotary drilling equipment, 8 sessions.
   5. Rotary drilling methods, 14 sessions.
   6. Cable-tool drilling, 6 sessions.
   7. Locating the oil zone, 8 sessions.
   8. Cementing problems and methods, 5 sessions.
   9. Drilling in oil zone, 4 sessions.
   10. Completion methods, 10 sessions.
   11. Drilling mud, 4 sessions.
   12. Wire lines, 4 sessions.
   13. Prime movers, 6 sessions.
   14. Oil-field boilers, 4 sessions.
   15. Casing, drill pipe, and tubing, 4 sessions.
   16. Well abandonment, 4 sessions.

A class receiving instruction in piping design



II. Production methods and problems:
   1. Well completion methods, 4 sessions.
   2. Equipment and operation of natural and artificial-flowing wells, 14 sessions.
   3. Equipment and operation of pumping wells, 16 sessions.
   4. Water problems and subsurface repairs, 12 sessions.
   5. Prime movers and power transmission, 10 sessions.
   6. Gathering systems and related problems, 10 sessions.
   7. Reservoir control and pressure maintenance, 6 sessions.

III. Pipe-line methods and problems:
   1. Pumping plant problems, 8 sessions.
   2. Field gauging methods and problems, 6 sessions.
   3. Pipe-line maintenance, 8 sessions.
   4. Dispatching, 4 sessions.

IV. Natural gasoline plant operation and problems:
   1. Gathering systems, 3 sessions.
   2. The absorption plant, 9 sessions.
   3. The compressor plant, 8 sessions.
   4. Pumps and pump drives, 5 sessions.
   5. Heat exchangers, cooling towers, and boilers, 7 sessions.
   6. Gas metering, testing, 4 sessions.

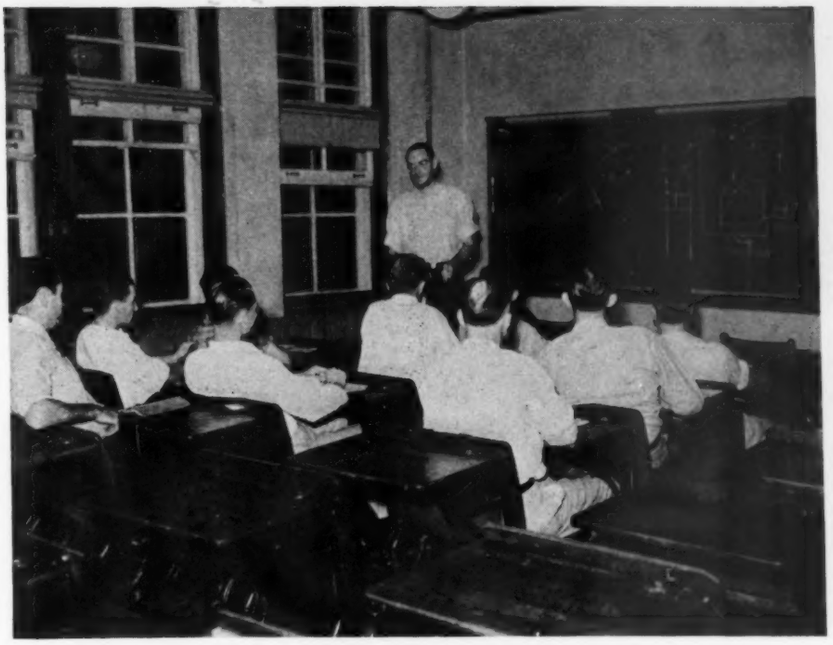
V. Basic courses:
   1. Oil-field mathematics, 30 sessions.
   2. Oil-field science, 30 sessions.

Petroleum the Leader

Although the oil industry was perhaps slow in taking advantage of the Smith-Hughes Act and its Federal-State-local educational program, oil soon topped any other industry in its use of the program.

A survey published in 1936 by the National Industrial Conference Board showed that 5.4 percent of all petroleum companies contacted were coöperating with the Federal Government in employee training. The next highest percentage was in the iron and steel industry, where 3 percent of all companies contacted were coöperating. Since then many more of the oil companies, both large and small, have been represented by employees taking training in the oil states where the programs are most extensive. The oil industry also scores high in foreman training work, most of it done by the companies themselves in company classes.

Some of the companies also have other classes supplementing the state coöperative program. In most cases, these courses are survivors of the individual company's former training program and offer the workers opportunities not readily available through other sources.



Even in fields where the number of workmen is limited and classes necessarily small, expert instruction is available

Company Plan

For instance, one highly progressive company in addition to coöperating with the State and Federal governments and the A.P.I. in the standard courses, has an extensive educational program of its own. This includes several intensive and highly technical courses in refining processes. These are open to refinery men of exceptional ability and education, including many graduates from college courses in petroleum. The courses supplement the work given in the colleges, some of which do not have adequate equipment to train their students completely in the latest refining methods.

Shorter and simpler courses also are given by the company for experienced refinery workers to keep them posted on new methods and processes. The popularity of these voluntary classes is seen in the company's enrollment record showing one-fifth of total refinery employees as having taken the work at some time. From 6 to 8 percent of the total is enrolled during the course of a year.

Courses for pumpers, giving various methods of lifting and acquainting them with the routine of the job, are also popular, as are special company courses in engines used in the oil fields.

This company also offers employees free classes beyond the scope of the mechanical training given in the cooperative program.

Included is instruction in geology, scientific prospecting, blocking acreage, figuring well costs, operations of a land department, etc. For its strictly office employees, this corporation makes available courses in business English, bookkeeping, accounting 1, 2, and 3, shorthand, typing, stenotyping, secretarial duties, etc. In fact, there is virtually no division of its operations except executive in which instruction fitting the employee for a better understanding of his job or for a better job, is not offered him by his company. Some of this company's courses, notably first aid, were begun 15 years ago.

Some of the oil companies conduct craft schools of their own in the trades useful to the oil industry.

Apprentice Training

One large oil corporation has had its own apprentice training program for 22 years. Covering a total of four years, the training takes the apprentice through eight periods of six months each during which he works the same number of hours as is scheduled for the department in which he is employed. Upon completion of the prescribed course, the new craftsman is presented with a certificate of service covering the work done and a signed statement as to its being satisfactorily performed. Preference is given sons of company

Oil-field science is a popular subject among workmen. This photo was taken at Paola, Kansas

employees for any apprentice vacancies that occur.

Some of the companies without educational facilities of their own reimburse their employees for a part of the cost of any courses related to their jobs that the workers may complete.

For instance, in the days before cooperative courses were developed for the oil and gas industries, one large Texas producing company, a pioneer in educational work, encouraged its employees to take home-study courses from several of the larger correspondence schools. The worker was expected to advance the cost of the course himself. If he completed it in the time set by the school, he was repaid 75 to 100 percent of its cost. If he completed it at any time while still associated with the company, he was reimbursed for 50 to 75 percent of its cost.

A few of the companies used to pay back 100 percent of the cost of even the most expensive course to the employee who completed it. One corporation that was generous in reimbursing its workers for what they spent in improving themselves paid out a total of $25,000 for this in ten years. The records of this company show that more than one-third of all its employees who started such courses completed them while still in the company's employ.

Many of the oil companies stand ready to reimburse the worker for what he spends in enrolling for any of the numerous coöperative courses now so popular; however, the enrollment fees are so small with the Federal and State governments bearing most of the cost, that the employee is able to take any course he wants because no large initial cash outlay is required.

A few of the oil companies go even further than this.

During vacation time they provide field and plant jobs for a number of students of petroleum engineering and related subjects in colleges and universities. The student not only gets the practical experience to supplement his classroom and laboratory work but also earns enough to help him continue his technical education.

Furthermore, some engineering schools are conducted on the coöperative plan by which a student studies half a year and works half a year. Several of the leading oil companies cooperate with these schools to give half-year jobs to students along the lines that they study the other half-year.

A number of companies coöperate with state engineering schools to provide permanent jobs each year to graduates. The state oil regulatory bodies, such as the Texas Railroad Commission, which depend upon the oil industry for their financial support, also take a number of the graduates each year, working them into the engineering supervisory forces of the state.

Advanced Training

In some exceptional cases, where highly technical and specialized instruction is needed by a company employee, an oil company may even pay the cost of this course for its worker in a recognized college or technical school. The employee continues to draw his wages, or part of them, being paid to go to school as well as having his tuition provided.

At the present time, full courses in petroleum engineering are offered by 18 American universities, and two additional schools offer limited courses in petroleum. The number of students enrolled in petroleum engineering schools is now estimated at 3540, with graduates in 1939 numbering more than 400, a large increase over 1938 when 281 won diplomas.

As would be expected, the best of these petroleum engineering schools are situated in the leading oil states, some of which have several such schools for the convenience of students. Most of these colleges are state institutions and have no tuition charges, or only small fees, for the young oil worker seeking a more extensive technical education in the oil and gas industries than the vocational courses can give.

Like the oil industry, the natural gas industry is keenly interested in providing educational facilities for its employees.

Company Interest

The companies are keenly interested in what employees are taking the courses and are anxious to give recognition for their successful completion of the work, a check of the files of the state supervisors of vocational training in the oil states shows.

For instance, one large company writes, "We acknowledge your letter of.....transmitting two vocational education certificates. We are following your suggestion and are presenting these certificates to our local superintendents with a letter commending the men on their satisfactory completion of these courses. We feel that such training should better fit our employees to perform the duties of their present job and increase their chances for promotion. As suggested, we are requesting our superintendents to encourage our employees to avail themselves of this opportunity."

An official of a well-known Mid-Continent production company writes, "We greatly appreciate your sending the names of the company men attending the petroleum industry education classes, and want to assure you that we are very much interested in this work. I should like you to send the class certificates to this office in order that I may write a letter of commendation to the foremen and superintendents for their coöperation in this work."

An independent pipe line company official writes, "I have your letter of

.....with which you enclosed a list of our employees who have been taking petroleum training courses. We are very much interested in knowing what employees are attempting to improve themselves, and therefore appreciate the information you gave us."

That the superintendents are interested in more men taking the courses is indicated from a typical letter from a district superintendent for a Tulsa company: "Wish to acknowledge receipt of literature pertaining to the educational program for oil field workers. As I am very much in favor of advancing the education of the men working for me, will acquaint everyone with the information received so that anyone desiring to enroll may have no trouble in doing so."

State Cooperation

Along this line, James R. D. Eddy, director of industrial education in Texas, recently pointed out, "Most companies request that they be furnished lists of their men who receive certificates. Most companies manifest a lively interest in maintaining the program and extending it to new fields.

"Quite a number of men have taken five or more of the courses, and are continually asking that new courses be offered. They are eager to assist in outlining and organizing new courses. This in itself constitutes the greatest proof of the value of the work. One example of the value of the work was a class in elementary mathematics composed of engineering college graduates. They took as much interest in the work as any other group and stayed with the course until completed."

The keen interest shown in the courses by all persons concerned in the oil industry was commended to the writer recently by Laurence Parker, state supervisor of trade and industrial education for Kansas.

"While we have been engaged in the promotion of evening classes for workmen in various industries for many years," Mr. Parker said, "our contacts with the oil industry were a surprise to us.

"We found that the officials of the companies were willing to go to great lengths in order to assure the success of classes for their employees. We found that the American Petroleum Institute was willing to devote considerable time and expense to the formulation of courses of instruction which should fit as exactly as possible the needs of the workers. We found that the workers themselves were eager for more knowledge of the work they were doing.

Much of the success of the program has been due to the fact that enrollment in the classes has been voluntary.

In the field where the student can visualize the hazards is an excellent place to give safety instructions

At first a few of the companies, confronted with the problem of selling the value of the courses to the employees, may have exerted some pressure on their workers to enroll. Most of the managements, however, realized from the start that for an educational program to be successful in any company or industry, it must be strictly voluntary on the employee's part. This plan was followed generally in the oil industry and those companies that promoted their programs on this basis have achieved the best results.

Oil's Laboratory

One of the principal reasons for the success of the instruction has been the free use of equipment as provided by the oil companies. Most of the managements have coöperated to the fullest extent in permitting the classes to study and even tear down and reassemble various kinds of drilling, producing, and pumping machinery in general use. Many companies have provided meeting places for the classes when it was desirable to hold these where the equipment was in service, in pumping stations, on leases, or in refineries. The value of such practical facilities, provided by the companies without cost to the students, cannot be estimated.

Lacking such coöperation, many of the courses would have lost all their usefulness, as it would have been impossible for the state vocational training departments to supply the many expensive types of equipment in general use throughout the oil industry. Even the colleges specializing in petroleum engineering courses cannot match this vast operating laboratory of the fifteen billion dollar oil industry, opened without cost to any oil employee.

The oil industry shares not only its equipment but also its experience with the members of its organization. Prepared with the closest coöperation of experts in each phase of the oil business, the vocational courses offered the worker at virtually no cost are the distillation of years of expensive experimenting to find the best way to do a job. All this is made available to the oil employee in concentrated and practical form. No other industry has gone so far to open up to its members its storehouse of experience and toolhouse of equipment to enable the worker to do his job better and to get ready for the job ahead.

Hidden Talent

An interesting summary of the value of such training to the employee was given recently by A. W. Breeland, secretary of the committee preparing the coöperative oil courses, in a talk on the educational program.

"One of the real reasons for vocational training in the petroleum industry, or for any industry as far as that

Many accidents to workmen whose duties involve the operation and maintenance of machinery are averted by proper instruction

is concerned," Mr. Breeland commented, "is to give to the employee a *greater appreciation of his industry.* From the worker's standpoint, vocational training is highly desirable for several reasons, among which are the following:

"Processes and methods are changing and if a workman is to keep up with the trends in his industry, it is essential that he do some study outside his particular job.

"The day of specialists in the industry has somewhat changed. While it is true that we continue to have, and will always have, need for specialists in certain lines, nevertheless the time is here when a man in the power plant needs not only to know how to time an engine and pack a valve, but he must also be a machinist, an electrician, pump expert and all-around repairman as well. It becomes necessary, therefore, instead of specializing in one operation that he become familiar with every piece of equipment in his plant. Particularly is this true in the petroleum industry where there are countless hundreds of small, isolated stations and plants with only one man on duty at a time.

"At the time the petroleum industry's vocational training program was organized, the hours of the average worker had been reduced considerably, and he therefore had more leisure time for study and other purposes. It was felt that our workmen would welcome an opportunity to improve themselves during this leisure time. Our experience has certainly verified this conclusion.

"The competition for jobs has also become keener and employers are more exacting in their requirements for trained men. Furthermore, a man who is trained not only to do a job correctly but who knows why he performs operations in a certain manner (that is, the theory as well as the practical side) is certainly a more satisfied worker and naturally takes more pride in a job well done.

"And last, but not least, earning capacity and the possibility of promotion and a higher standard of living increase with training. . . . Very often as a result of a vocational training program, hidden talent is discovered and square pegs can be removed from round holes and made to serve a more useful purpose in the company and at the same time give the worker a greater degree of satisfaction and happiness in his work, which, after all, is the ultimate goal to be reached."

All this informal discussion of the educational opportunities for the employee in oil or natural gas should help materially in answering a question.

Success Story

It has not been necessary to ask that question because an ambitious employee doubtless asks it of himself many times a year: "How can I get ahead faster in the oil business?"

In fact, the question is worthwhile only when the employee himself shows the initiative and ambition to ask it.

The answer also is worthwhile only when the worker himself finds it. For no one else can answer it for him.

The oil industry has done everything in its power to make available to its workers the tools of knowledge and equipment. Any member of the industry can make them his for the asking. If he does not wish to, however, certainly no one will force him to. It is an option that each member of the oil business exercises for himself, or not, as he chooses.

If he does take up the option and makes full use of his chances for learning more about the job he has and the jobs in front of him, no other industry will reward him more richly. And no other industry is more likely to reward him. Almost never does the oil business or the individual oil company step outside its own ranks to fill a vacancy. If you do not get the job, someone working beside you may. Many of the industry's leaders including perhaps the chief executives of your own company started from scratch, perhaps in the same kind of job you did and with perhaps less training and certainly fewer chances for acquiring it than you have.

An analysis of the careers of the heads of the 20 largest American oil companies shows some interesting facts.

Of the 17 big-company heads who are listed in "Who's Who in America," only three have had any formal technical education. And due to the fact that at that time there was virtually no instruction in petroleum engineering available, this had to be general engineering courses with little or no reference to oil.

Four more of the leading company chieftains took law courses, and four others completed literary or academic courses leading to a college A.B. degree. Five of the largest corporation heads have had no technical school or college training at all!

Of the latter group, Edward G. Seubert of the Standard of Indiana entered the employ of the company he now heads, at the age of 15 as a clerk, after he had finished high school. T. Rieber, chairman of the board of The Texas Corporation, was master of a tanker and received his formal school training in a Norwegian naval academy. Henry L. Doherty, president of Cities Service, began his business career at the age of 12 as an office boy with the Columbus Gas Company.

Frank Phillips completed grammar school as a prelude to one of the most successful careers in oil. W. G. Skelly

went to work for Oil Well Supply Company at the age of 14 after completing a business course. His first oil-field experience had been helping his father team supplies out to the early Pennsylvania fields. Harry F. Sinclair, one of the most colorful oil titans, took a single year in pharmacy at Kansas University, quitting school then to go to work.

Up the Ladder

Among the others, J. S. Cullinan, founder of The Texas Corporation and several other companies, received only a public school education in his native Pennsylvania. Of the old Texas official family, T. J. and A. M. Donoghue both were educated in the public and parochial schools of Pennsylvania, leaving school at the age of 13 to obtain jobs.

Known as the father of rotary drilling, and responsible for many other technical improvements in the oil industry, Captain J. F. Lucey had no formal technical education. At an age when most American youths were in school, this Irish immigrant lad was fighting for his adopted country in the Spanish-American War. His associate, Ralph E. Fair, never completed high school, entering the oil business as a roustabout in California at the age of 14. Correspondence courses and private tutoring in mechanical engineering, which he continued until he was 35, made up his personal educational program.

H. R. Cullen received all his formal education in the public schools of San Antonio. James M. West also received a public school education. E. R. Fain of Fain and McGaha had only a high school education. Even the renowned Julius Fohs got a great deal of his education by home study after completing high school.

Among the younger corporation executives are many whose careers are as notable as those of the old-time company founders. For instance, D. A. Little, president of the Magnolia Petroleum Company, did not enter the oil business until he was 27. Then a postal clerk at Corsicana, he joined the Magnolia as a bookkeeper. The vice-president and general manager of the same company, L. S. Sinclair, had only a public school education in Mexia. The late Fred M. Lege, Jr., vice-president for marketing for Magnolia for many years, began his business life as a messenger boy after a public school education.

In Oklahoma the examples of outstanding oil success without benefit of higher education are so many as to be almost the rule instead of the exception. Of the early petroleum giants, few had any college or technical school background. And yet they laid the foundations of the huge Mid-Continent oil industry.

Among them were the philanthropic Charles Page whose first job was as a messenger boy and who later was a Pinkerton detective; the fabulous Joshua S. Cosden, whose education in the public schools of Baltimore was followed by a career as spectacular as any in the colorful annals of petroleum, and the gargantuan T. N. Barnsdall, son of an English shoemaker.

The present head of the Barnsdall Company, E. B. Reeser, is another who grew up in the oil business without any special schooling. Mr. Reeser left the public schools of his native Pennsylvania when he was 15 to get a job as messenger boy. When he was 18 he entered the oil business as office boy with the Standard Oil Company at Oil City, Pennsylvania.

Lew Wentz received a public school education in Pittsburgh before starting one of the most successful careers of any independent operator. J. E. Crosbie entered the oil game as a tooldresser at the age of 16. The Ramseys, W. R. and W. E., attended only the subscription schools of early Indian Territory. J. Steve Anderson received a high school education, which he supplemented by private study of law.

Dozens more could be named both from the ranks of independent operators and major company officials. In fact, a series of volumes might well be written on the success stories of these and other leading oilmen.

Enough of them have succeeded without any technical education and even very little common schooling, to demonstrate that lack of education is not an insurmountable handicap.

Increasingly, however, preference is being given by the industry to the trained man—not necessarily the college graduate, but to the man who knows how to get the job done. Frequently this is the man who learned how on the job or in one of the vocational training classes sponsored by the industry. Today with competition for jobs the keenest in American industrial history, it is more than ever the trained man who wins. Furthermore, the industry has made training available to every worker who wishes it enough to make it his. It is still true that the best invitation to opportunity is preparation.

Safety Insurance

Learning more about your work is not only good job insurance, it is also the best kind of accident insurance.

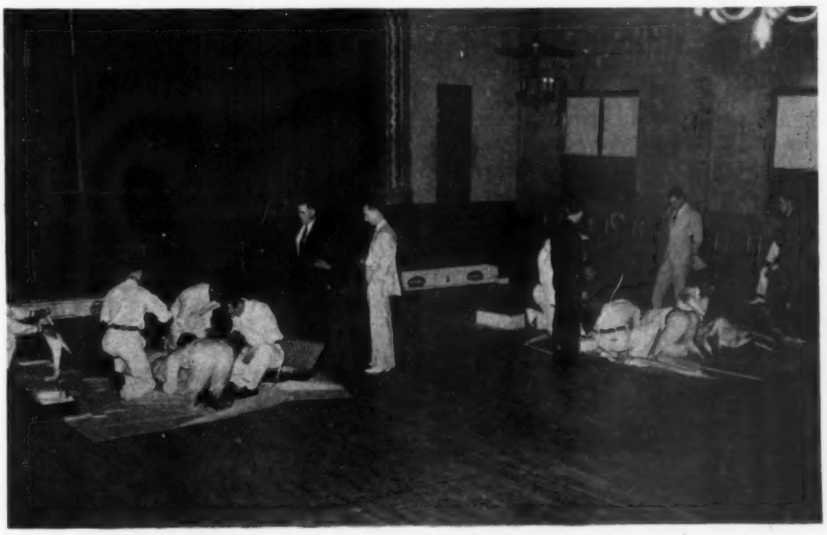
The other day the writer, in talking with an expert on oil safety, asked him the question, "What is the best protection an oil worker can give himself against accidents?"

The expert's immediate answer was, "Understand his job."

"It's easy enough for a foreman to say after a man is injured or killed, 'I told Bill to be careful'," continued the safety authority, H. N. Blakeslee, head of the American Petroleum Institute's department of accident prevention and secretary of the petroleum section of the National Safety Council.

"But that isn't enough. It's just like telling your boy to look both ways before crossing the street. A lot of them do that and still get run over and killed.

Oil industry employees acquiring skill in first-aid technique



"But, as one friend of mine did, if you tell him to stop and look both ways until he whistles through 'Yankee Doodle,' then he's pretty likely to wait until he can make a safe crossing. The point is that while the foreman may have told Bill to be careful, he didn't tell him how to be careful.

"One of the first things to know about accidents is that they never happen. Accidents are always the result of a set of conditions. To be specific, they are caused by three things: first, ignorance; second, indifference, and third, insubordination, on the part of the worker. The last two naturally are seldom the causes. It is almost always the first that is responsible—ignorance. That's why an accident is so often the foreman's fault, because he didn't make the man understand how to do his job.

"If a man is fully informed on how to do his work and why it is done that way, he doesn't need to be told to keep his mind on his job. If he has been provided the necessary information, if he understands his job, his mind functions with it. So the more encouragement he is given to study his job and learn it, the more certain he is to keep his mind on it. And the more he keeps his mind on his job, the more certain he is to be safe from accidents while performing it."

Accident Costs

In connection with the benefits of training, Mr. Blakeslee cited the experience of one of the larger Mid-Continent gas companies. A few years ago, this company was engaged in a construction program extending from Texas to North Dakota on which it handled all sorts of heavy equipment and materials in weather ranging from extremely hot to several degrees below zero.

The men on the work were carefully selected from the company's regular operating organization, each man being chosen for a particular type of work for which he had been trained and for which he had demonstrated skill. During this time there were several thousand man-hours of exposure. Yet the men had only two disabling injuries, one of these being a strained back from pushing a truck out of a quicksand creek bed.

Shortly afterward the company followed the same policy in building a compressor station containing 15 gas-engine-driven compressor units and necessary auxiliary equipment. Most of the construction crew were drawn from the company's regular operating force, key men being selected for particular jobs for which they were trained. The plant was built and put into operation without a single disabling injury.

During the same year the same company had a small pipe-line construction program, the personnel for which (with the exception of a skeleton crew) was selected locally for the duration of the job. Most of the men were untrained. The result was that more than 28 percent of all the company's accidents for the entire year took place on this one project, on which the organization had less than 2 percent of its total man-hours-exposure!

A striking achievement when this company had got its employee-training program into full operation was that its own accidents were reduced by 10 percent, although all industrial accidents increased 6 percent.

In explaining this showing, the head of the company's safety and employee training programs reported: "If an organization has the right kind of supervisors; if the same care is exercised in the selection of workmen as is exercised in the selection of materials and equipment; if a system of training is inaugurated that will insure each and every individual's being thoroughly familiar with the inherent hazards in connection his particular job and how to apply safeguards and protective devices to minimize these hazards, then the job will be done correctly and when the job has been done correctly, it will have been done safely."

2078 Years

That progress is being made by the many safety agencies in their fight to protect the oil worker from injury or death is seen in figures recently announced. Showing the odds against disabling injuries in the American petroleum industry today, the latest report indicates that an oil worker can be on the job 33 years without meeting an accident. As late as 1937, the odds against disabling injuries were only 11 to 1. Today fatalities in the petroleum industry are at the rate of only one in 2078 years.

The cash value of safety is strikingly presented in figures recently prepared by Mr. Blakeslee. Had the 1927 rate of oil injuries (31.15 disabling injuries per one million hours worked) continued until 1937, there would have been 84,502 more workers suffering disabling injuries than actually did. Figuring the cost of such an injury as $300 (insurance company average) a total of $25,350,600 was saved by preventing these injuries. This does not take into consideration savings from the minor injuries prevented, property damage prevented, and interruptions in work prevented. There is, of course, no way to estimate these savings, or more important, the pain and anguish prevented.

To date, these savings have been swelled still further to approximately $30,000,000 for the last 12 years.

Each year oil is making itself a safer industry. Figures for 1938 recently announced by the National Safety Council show that the petroleum industry rate was 12.64 per million man-hours of exposure, for frequency, and 1.59 for severity. These represent a reduction of 15 percent below the 1937 frequency and of 7 percent below the 1937 severity. The year 1938 was the second successive year in which both rates were cut compared with a previous year.

Over a longer period, the gains made are even more impressive. Since 1926, improvement in frequency has amounted to 66 percent and in severity to 30 percent.

Of all departments of the industry, manufacturing had the lowest frequency rates in 1938, averaging 8.78. Oil pipe lines made the most improvement in frequency compared with 1937, or 34 percent. The most important types of compensable accidents in the oil industry, it is indicated by state reports, are "handling objects" and "falls to the same level," which account for 48 percent or nearly half of all types.

Comparisons

Judging by frequency of injury, the petroleum industry in 1938 was the 17th safest in the nation out of 30 larger industries. Ranked by severity of injury, petroleum stood 20th.

These figures, however, hardly show what progress has been made by petroleum in protecting its workers compared with other industries of the same type. For instance, mining, a similar industry, stands 29th in frequency with a rate of 37, and 30th in severity, with 10.84, virtually at the bottom of the list. Cement, although 2nd in frequency, is 25th in severity, with 2.44, which is the real test of an industry's safety program. Construction was 27th with frequency of 24.93 and severity of 3.24. Quarrying, although 15th in frequency with 10.66, was 29th in severity with 4.62.

The same explanation applies to the comparison of rates for all industry and for petroleum. With petroleum's frequency rate in 1938 being 12.64, that for all industries was 12.16. Petroleum's severity rate was 1.59 whereas for all industries it was 1.53. But included in "all industries" are some almost accident-free types of business as tobacco, printing, rubber, leather working, and the like. The exceptional showing made by petroleum in com-

parison with such industries as these emphasizes the fine safety record that the oil industry has established.

Among companies in the oil industry, the larger organizations had the lowest 1938 injury rates, averaging 12.21 for frequency and 1.47 for severity, or below even the average for all types of industries. The larger companies also had the best records compared with 1937, reducing frequency by 15 percent and severity by 12 percent.

Smaller Companies

That is due, of course, to the greater attention paid safety by the larger companies, and their efficiently manned and thoroughly organized safety departments. Some of the smaller operators have dismissed suggestions for a safety program, to be conducted by one of their present staff on a part-time basis, because "it would cost more than it was worth."

The actual experience of smaller companies in California who have kept check on their losses shows quite the contrary. For instance, the insurance company for one firm having 200 employees had paid out $9000 in medical and compensation payments for them in the first half of 1937. The oil company then coöperated in a safety program. Payments during the first half of 1938 declined to $700.

Another company having 190 men in its drilling and production departments suffered an accident loss of only $58 for the first six months of 1938. A reduction of $1600 in total payments for a company of 195 employees was reported in the same period, and another reported a decrease of 56 percent in the frequency of accidents.

These dollars-and-cents results all followed the adoption of a coöperative safety program through the California Petroleum Safety Board, formed by a group of smaller companies to serve as their safety organization.

In another area, a company that had been paying out approximately $75 per employee per year due to accidents and attendant losses, put in its own safety program handled by one of the regular employees as a part-time job. The safety work cut the loss the next year to $3 per employee. The company decided that instead of not being able to afford a safety program, it could not afford to be without one.

Off the Job

In connection with establishing an accident prevention program, or making more effective an existing one, a few ideas gleaned in 21 years of oil safety experience by Mr. Blakeslee might prove interesting.

"Any oil safety program should start with first-aid instruction for the members of the organization," he suggested. "Not only does it enable the employee to know how to protect himself and his associates but also it presents safety as something pertaining to himself. He unconsciously comes to realize the consequences of injury in terms of himself, and that makes him much more careful.

"And not only is first-aid valuable in preventing injuries from being serious on the job, but also it is immensely valuable, sometimes even more so, off the job and after hours. For an employee who is injured off the job is a worse loss to his family who depend upon him for support than if he was hurt on the job where he would receive compensation. And, of course, he is just as much a loss to his community when his buying power is reduced, no matter how his accident happened.

"A safety program is valuable in the degree to which it is brought close to the employee. In other words, a classification of causes of accidents may not mean a thing to a worker. But an analysis of an accident to the man who works next to him, may keep him from a similar injury. Always use the examples available and point out the conditions leading up to them.

"And one of the greatest assets to any accident prevention program is the interest of the chief executive. In one of the larger companies, the safety director reports directly to the president of the corporation. In another, the superintendent or foreman under whom an accident happens has to go to the head of the company and explain it. This has been one of the strongest deterrents to accidents in this organization. As they say, 'We can't have an accident, because if we did, we'd have to tell the Old Man why!' "

Safety Manuals

The objection of some employers that their men "don't have time to read safety material" is not always true, the safety authority commented.

"In fact," he added, "if it's something that's about his job, you can't keep him from reading it."

Many of the best parts of the numerous accident prevention manuals that the American Petroleum Institute issues are the result of contributions from the man on the job. A very effective way to be sure the worker reads the manual is to hand him one and ask him if it is right. Lots of times the man comes back with the comment that it is wrong in a certain particular, and then, Blakeslee admitted, "I usually find the man is right."

Today tens of thousands of these many safety manuals for the various operations of the industry have been distributed. Some of them have been adopted as standard by numerous other industries.

The American Petroleum Institute, of course, is only one of the numerous agencies coöperating with the oil industry to reduce accidents among its employees.

Leadership in all phases of safety activity is taken by the National Safety Council, with which the A.P.I. department of safety works closely in its own industry. All the larger companies and many of the middle-sized ones maintain accident prevention departments supervised by men trained in that work. Many other smaller companies also have a safety program directed by an assistant superintendent or other junior executive as part of his duties.

Through the National Safety Council, American Petroleum Institute's department of accident prevention, Mid-Continent Oil and Gas Association, Safety Engineers Club of Houston, American Society of Safety Engineers, California Oil and Gas Association, California Petroleum Safety Board, Western Petroleum Refiners' Association, American Society for Testing Materials, American Society of Mechanical Engineers, U. S. Bureau of Mines, and other groups, the latest in safety practices is made available today to even the smallest oil company.

Increasing recognition has been given the industry's safety work at the oil expositions, with first-aid contests in which teams from companies all over the oil country compete for prizes. The contests, while showing only a portion of the first-aid work given, have emphasized in spectacular fashion the efficiency of such training and brought home its value in the field.

Also aiding in promoting safety-mindedness throughout the oil industry is the increasing number of petroleum school graduates, many of whom have had courses in safety practices and upon whom the importance of preventing accidents has been impressed.

Fire Prevention

Closely allied with accident prevention is fire prevention, particularly in refineries. Active in this work among employees of refineries in western Pennsylvania, Ohio, and West Virginia, the Fire Marshals Group of the National Petroleum Association has had an important part in reducing losses. Fire losses at American refineries in 1930 of 18.9 cents per $100 of insurable value were reduced to 10.2 cents in 1938, and for all divisions the reduc-

tion was from 14.9 cents to 7 cents per $100 of insurable value, the result of work by the various fire prevention groups of the industry.

Considering the highly inflammable nature of oil and its products, next most dangerous to explosives, the fire loss record set by the petroleum industry is remarkable. In 1937, with a total of 68,951 properties representing insurable value of $859,050,014 (without oil stocks), the industry's total fire loss was only $600,056. Counting in oil stocks, insurable value rises to $1,253,423,785, and fire loss totalled $742,000, a ratio of only 5.9 cents per $100.

The close relationship between fire prevention and accident prevention has led to their union in the safety programs of some of the companies.

Model Set-up

For instance, one progressive operating company in the Mid-Continent has combined its protection program in an "accident and fire prevention department." All its safety activities in all departments except refining are directed by this combined department. Due to the concentrated nature of the refining operations (already under close supervision by the refining department heads) and to the peculiar problems of this end of the business, this department conducts its own safety program.

Because of this company's extensive producing activities, the southwestern states in which it operates have been divided into districts and a safety supervisor placed in charge of each. Each supervisor is responsible for all accident and fire prevention work in the drilling, producing, natural gas and gasoline, and pipe-line departments in his district.

The safety program is carried from the head of the company's accident and fire prevention department to the man in the field through: (1) Frequent headquarters conferences of the safety director with his safety supervisor. (2) Field conferences of each supervisor with each of the superintendents or foremen in his district. (3) Regular monthly (and sometimes special called) conferences of each superitendent or foreman with his men.

To carry out details of the safety program, each group of 15 to 40 employees has its own safety committee of three—the foreman and two men. This committee inspects properties, detects unsafe conditions and makes recommendations for their correction. At the conferences all of the men are invited to make safety suggestions growing out of their experience on the job.

At least every 60 days each supervisor visits each part of his district. Posters of the National Safety Council and the popular four-page bulletins of the A.P.I., breezy in style and illustrated, are used, the former for bulletin boards and the latter for material for the foreman's conferences. For the more specific use of the foremen and superintendents, the company issues its own safety bulletin full of material relating directly to its operations. Many of the best suggestions for safety practices come from the men themselves, being sent on to headquarters and spread from there to the other districts of company operation.

For employees whose eyes are endangered, the company provides safety goggles, and for others makes available at cost safety or "hard boiled" hats and safety shoes with steel-reinforced toe caps. First-aid supplies are stocked by the company warehouses and supplied without cost to the men, each district ordering its probable requirements a month in advance.

The company has been unusually successful in its first-aid training. Of its approximately 9000 employees, more than 75 percent of them have completed the U. S. Bureau of Mines course in first-aid and been issued A.P.I. certificates. The rapid spread of the instruction was effected by selecting key men in each district for teaching, these in turn holding classes in every company center.

Organization of its safety department with the same businesslike efficiency it has used in its marketing or production department has brought the company several safety awards from the American Petroleum Institute and National Safety Council. These trophies, representing the protection of men from death or injury, are keenly contested for throughout all branches of the industry. The plaques, although not large in size, loom imposingly in lives and human misery saved.

Safe Driving

Because of its keen interest in safety for its workers, the petroleum industry stands high among all American industries in certain types of accident prevention.

For instance, in motor-vehicle operation, the oil industry had only 1.45 accidents for each 100,000 miles of travel in 1937. This is the equivalent of one accident for each 68,333 miles of travel. The national average for all commercially-operated vehicles was one accident for each 45,000 miles. If the superior safety of the petroleum industry had prevailed on all cars and trucks driven, the motor-vehicle fatalities would have been 34.7 percent fewer, or 13,700 less. In other words, had all drivers been as safe as the petroleum industry's, 13,700 lives would have been saved that one year.

The Panhandle Refining Company, which had had a vehicle accident record so bad its compensation premiums carried a 31 percent penalty, has gone in so successfully for safety that it has won awards enough to cover its office walls. One of its numerous records was 2,061.967 miles with a single accident. In refining, the Whiting plant of the Standard Oil Company (Indiana) set a high mark of 3,631,697 man-hours without an accident. In marketing, the Continental Oil Company chalked up 2,960,497 man-hours without an injury. In producing, the Shell Oil Company, in its Tonkawa division, scored 1,413,299 accident-free hours of operation. Drilling, most beset by accidents, has a mark of 288,521 man-hours hung up by the Republic Production Company at which to shoot. In natural gasoline, the Shell has 1,403,165 hours without an accident to its credit, and the Hope Construction and Refining Company set a high of 1,444,722 hours in the pipe-line division.

Perhaps in terms of millions of hours, these records might seem to outsiders merely statistics. But to you in the oil business, they mean protection—protection from all the predictable hazards of your industry. To you they constitute the best guarantee that your industry and your company are doing everything in their power to make working in it safe for you.

They also constitute a tribute to you, you whose efficiency and care at your work have piled up, hour by hour and day by day, these tremendous totals of safety. Taken together they form a monument to your skill and caution and resourcefulness. And with the specialized vocational training now available at virtually no cost, to add even more to knowledge of the work, these figures of protection should mount even higher.

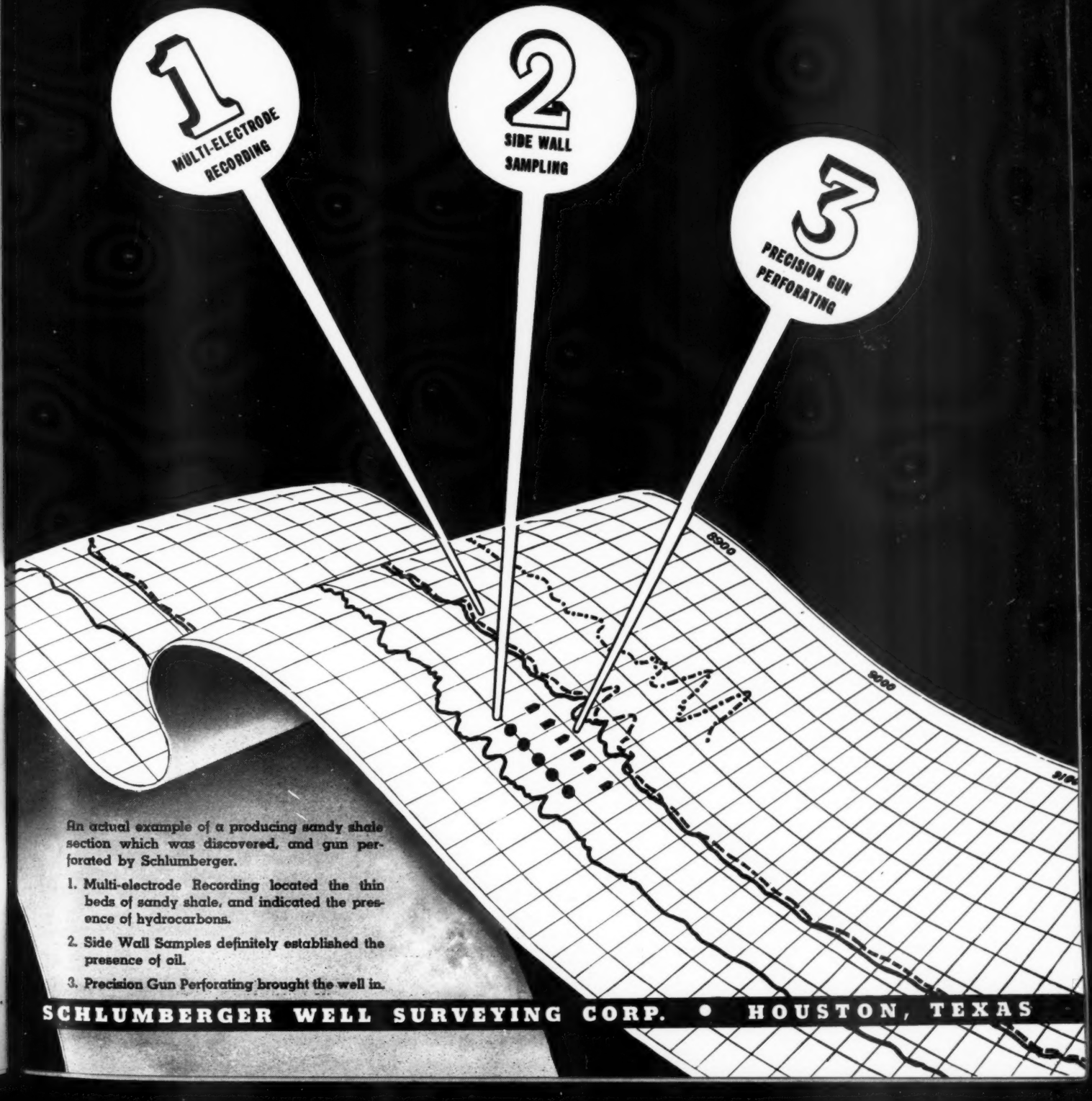
As the chairman of the industry's vocational program said recently: "Oil industry workers today realize that injuries resulting from accidents are expensive not only to the employer but also to themselves. They also realize that accidents that may cause injuries to them or damage to equipment are the result of mistakes usually due to the lack of understanding of some phase of the job.

"The vocational training courses are bringing about a better understanding and appreciation of the work to be done, and should be of material benefit in further reducing the accident rate and making the worker safer on his job."

For Greater Precision and Economy

SCHLUMBERGER

Offers These Three Companion Services



An actual example of a producing sandy shale section which was discovered, and gun perforated by Schlumberger.

1. Multi-electrode Recording located the thin beds of sandy shale, and indicated the presence of hydrocarbons.
2. Side Wall Samples definitely established the presence of oil.
3. Precision Gun Perforating brought the well in.

SCHLUMBERGER WELL SURVEYING CORP. • HOUSTON, TEXAS

P 615.222
P 622.24
P 590.6

Photoelastic Stress Studies of Various Types of Welded Joints

Lap joints, butt joints, and tee joints are subjected to this revealing method of analysis to determine the most efficient type of construction

By KENNETH N. MILLS
Chief Engineer, American Manufacturing Company of Texas

THE photoelastic method of analyzing the stress distribution in a machine element is one of the most exacting methods of stress analysis, because when a piece is subjected to this type of stress analysis the nature of the stresses existing in it are immediately apparent. For this reason, it presents a very potent device for checking the theoretical assumptions used in designing a machine. Also, it is an excellent method to use when attempting to determine the cause of some of the apparently unexplainable failures that occur in practice.

In this method of stress analysis, a beam of plane-polarized light is passed through a model of the part in question. The model is made of an isotropic translucent substance, such as celluloid. The polarized light passing through a celluloid model before the load is applied will show a rather dark gray image. If the model is a celluloid beam of constant bending moment, a

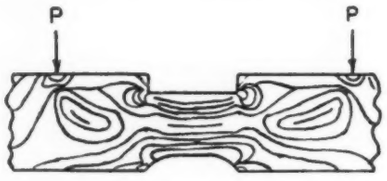


Fig. 1

series of parallel colored bands of light will be projected when the beam is under load. When the moment on the beam is applied, the extreme edges of the beam will project a yellow band. When the moment is increased, the yellow band will move toward the center of the beam, and, in its place, an orange band will appear. Further increase of the moment will cause the orange band to move inward and the edge to become red. This process will continue as the moment is increased, and the order of the bands from the center of the beam outward will be yellow, orange, red, violet, blue, green, yellow, orange, red, etc., to the extreme edge. If a photograph were made of this beam, it would show a series of parallel, equally spaced black and white bands.

The color and order of these bands have a definite relationship to the intensity of the shearing stress, and these colored bands are loci of points of equal maximum shearing stress. For this reason, these bands indicate the stress distribution in a body. From this information, points of stress concentration, therefore point of possible failure, can be located, and, by a process of trial and error, eliminated or modified.

For example, if a square and a rounded notch were cut in the foregoing beam, these bands would arrange themselves approximately as shown in Fig. 1. As these bands indicate lines of constant shearing stress, it can be seen that the stress is concentrated around the corners of these notches and the points P where the load is applied. It also can be seen that the degree of stress concentration is greater in the corners of the square notch than in those of the rounded notch. From these observations, it can be concluded that under a varying load, failure in this beam would begin in one corner of the angular notch.

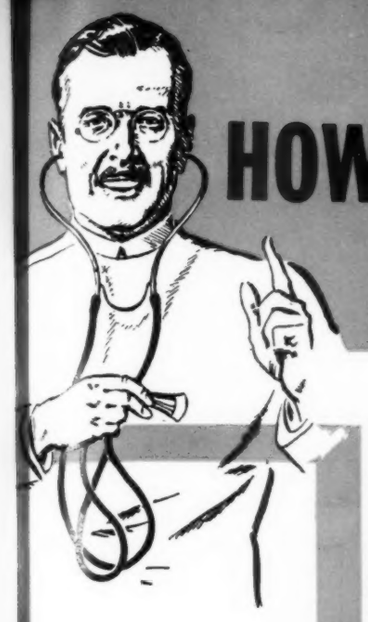
Some of the failures most difficult to understand occur in welded joints and structures. In nearly every case, they are caused by lack of consideration being given the stress condition produced either by the type of joint used, or by the type of weld used and its location. Generally speaking, the welded joint that appears outwardly to be the strongest is the weakest when subjected to a varying load. For this reason the practical man is often misled when selecting the type of joint to be used in a welded structure.

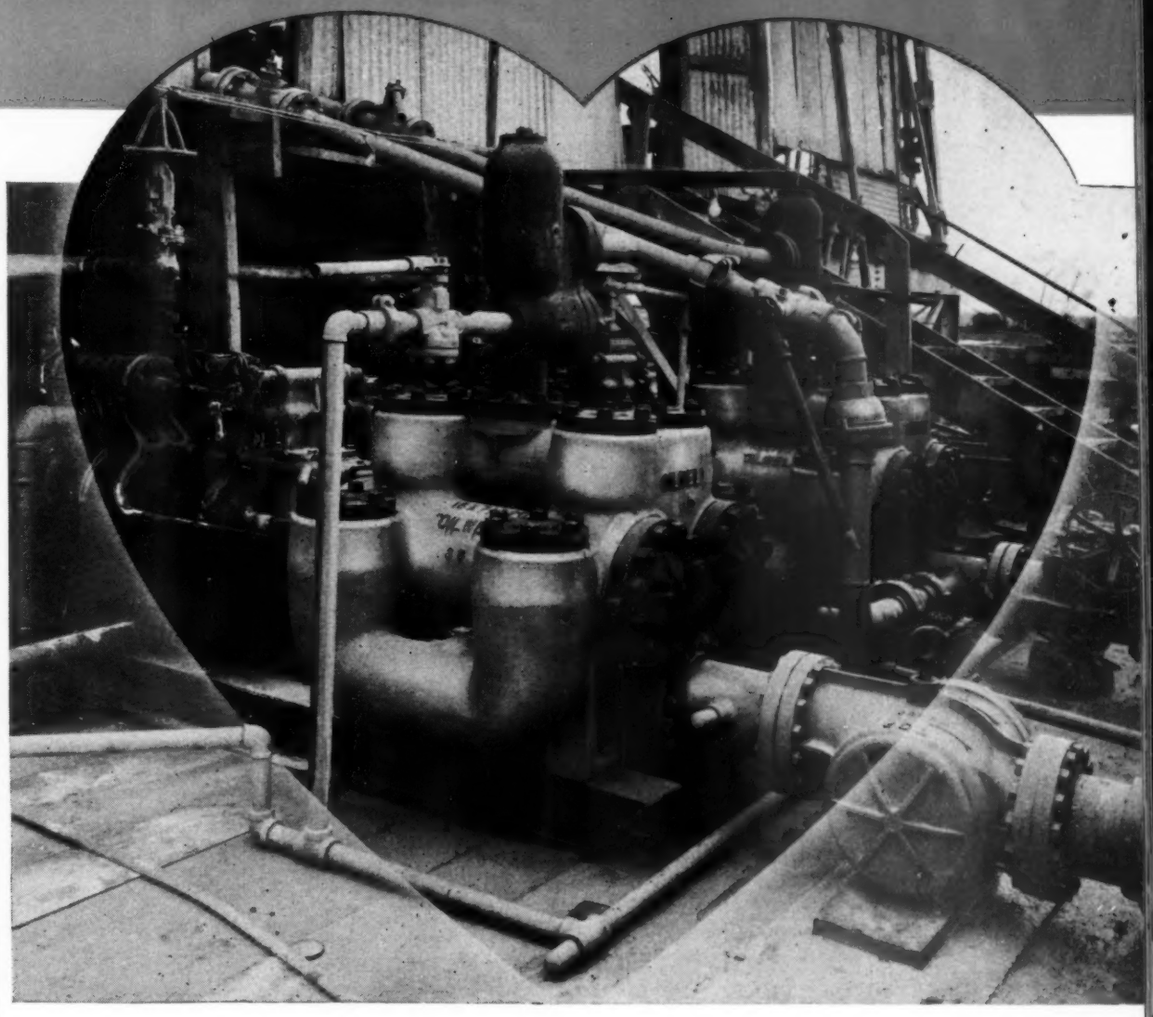
One of the most commonly used types of welded joints is the lap-type joint. This type joint is a holdover from riveted construction, and it is favored because it has two welds to carry the load. For this reason, it is assumed to have a very high efficiency. A photoelastic analysis of the stress distribution in a joint of this type having convex beads is shown in Fig. 2. In this photograph, it will be noted that the bands are crowded at the ends of the weld indicating points of high stress concentration. Also, it will be noted that the stress condition in the parent material is bending combined with tension, as the color of the parent material is not uniform and bands of color exist indicating the presence of bending stresses. Bending stress exists in this type of joint because the axes of the two plates are offset and do not intersect. A joint of this type will fail at the ends of the welds when subjected to a varying load, unless the stresses at these points are maintained at a safe value.

KENNETH N. MILLS

received a B.S. degree in mechanical engineering from Rice Institute, Houston, Texas, in 1933—He joined the engineering staff of the American Manufacturing Company of Texas, Fort Worth, in 1934 and was placed in charge of that department in 1935—During his association with the petroleum industry he has devoted considerable time to the analytical study of problems encountered in oil-well pumping.

HOW STOUT IS YOUR HEART?





KEEP IN THE THOROUGHBRED STRAIN!

For lowest operating cost specify only genuine "Oilwell" and Wilson-Snyder replacement parts. "Oilwell" DI-HARD liners, for example, give several times the service life of other liners and proportionately reduce the frequency of piston replacements. DI-HARD liners, given proper care, have established many outstanding records, including one exceeding 140,000 feet of drilling before replacement.

YOUR rig never gets laid up with "heart failure" or "low blood pressure" when there's an "Oilwell" or Wilson-Snyder Slush Pump on the job. These steam and power slush pumps are recognized throughout the oil fields for their smooth operation, dependability, high efficiency. They are the stout hearts of hundreds of drilling rigs.

Request complete information on the size and type that will best suit your requirements.

THERE IS A PUMP FOR EVERY APPLICATION IN THIS WIDE RANGE OF SIZES

STEAM PUMPS			*POWER PUMPS*	
16¼" x 7¾" x 20"	14" x 7¼" x 18"	7¾" x 20"	7¼" x 14"	6" x 12"
15" x 7¾" x 20"	12" x 6" x 16"	7¼" x 18"	6" x 16"	5" x 12"

OIL WELL SUPPLY COMPANY

"Oilwell"

Branch Stores In All Oil Fields

Subsidiary of United States Steel Corporation

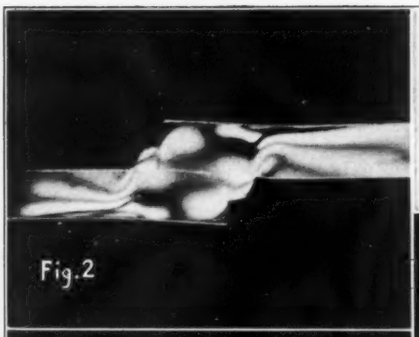


Fig. 2

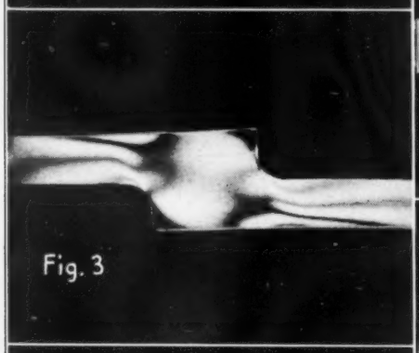


Fig. 3

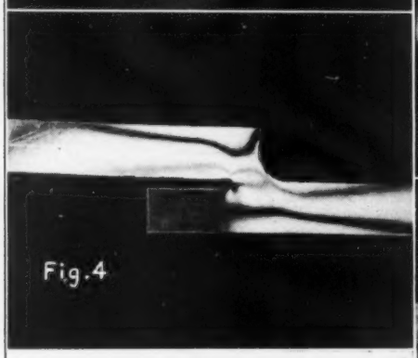


Fig. 4

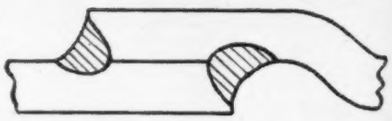


Fig. 5

Fig. 6

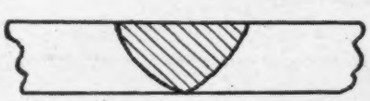


Fig. 7

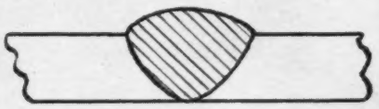


Fig. 8

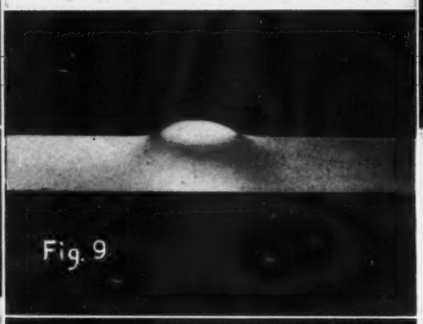


Fig. 9

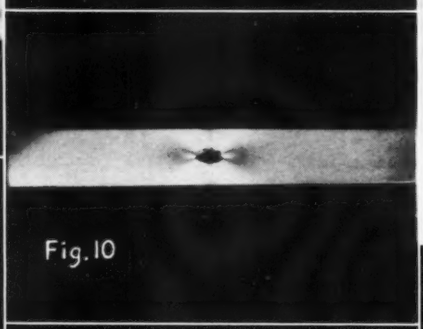


Fig. 10

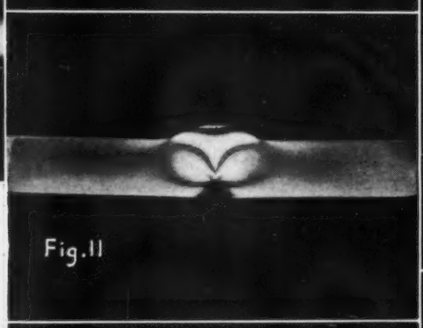


Fig. 11

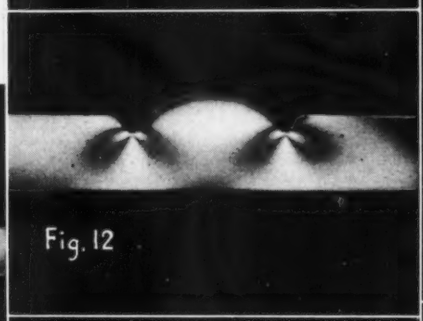


Fig. 12

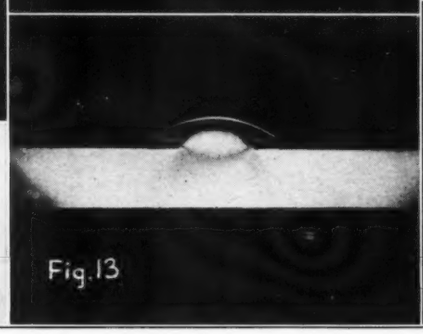


Fig. 13

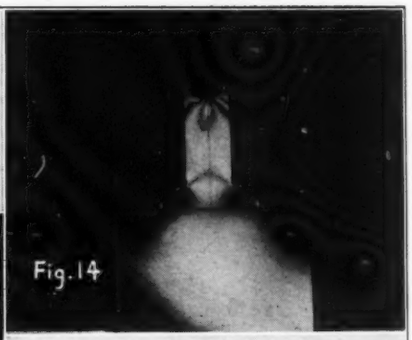


Fig. 14

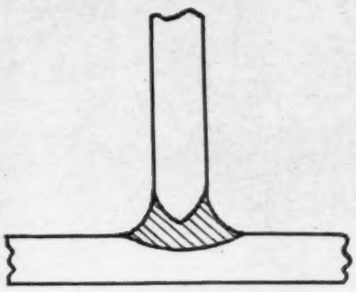


Fig. 15

Fig. 16

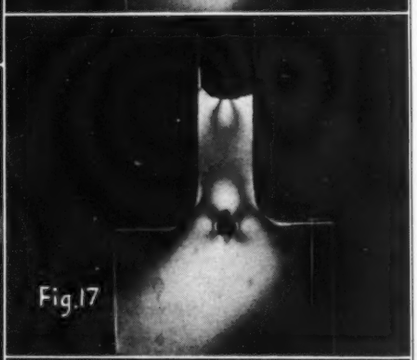


Fig. 17

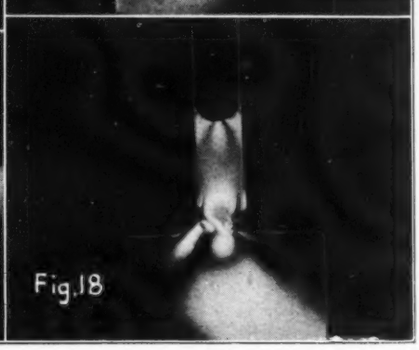
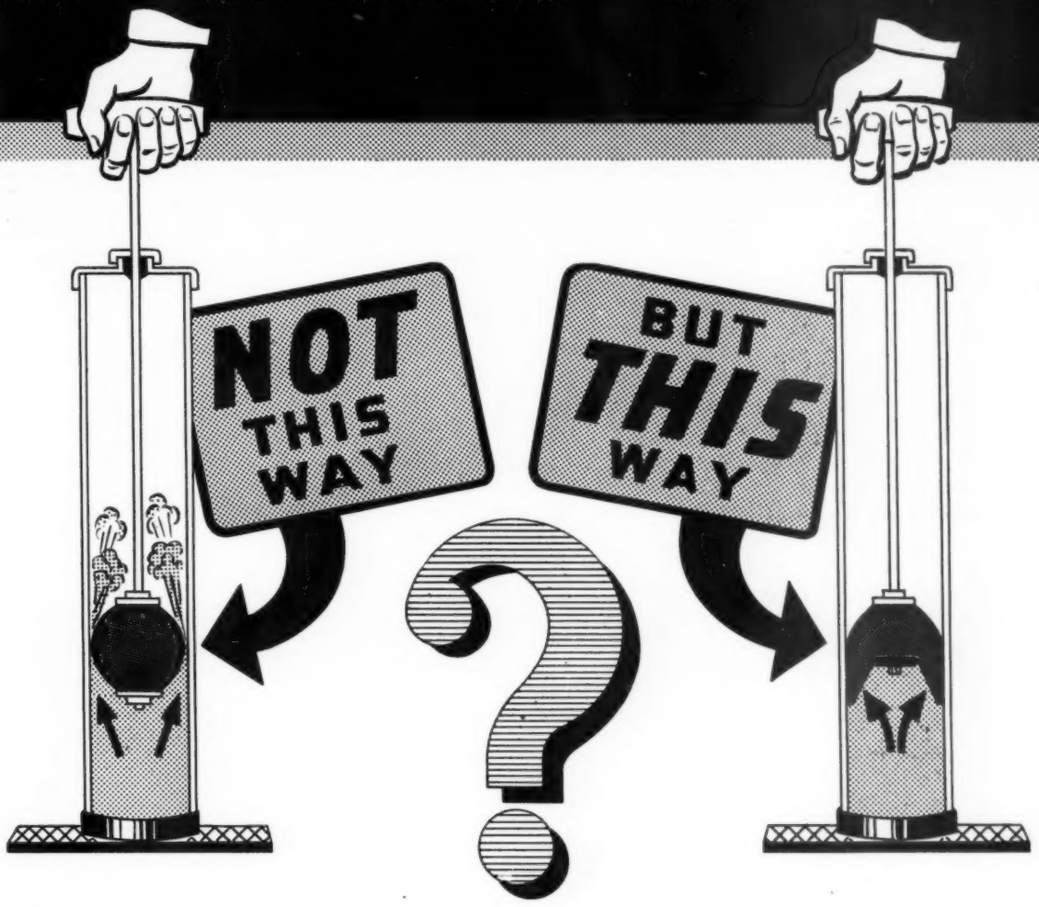


Fig. 18

WHY DO THEY BUILD *a* TIRE PUMP-



Guiberson
Type "K"
Swab

These illustrations represent blind force vs. strategy. The solid rubber thrusts downward, blind to the fact that the air pressure works directly against the rubber to force a passage past it. This type of pump could develop little pressure.

But the cupped rubber causes the air pressure to work with it to accomplish its purpose. The greater the air pressure, the tighter the seal between rubber and barrel. This type of pump can develop high pressures.

Exactly the same principle applies with swabs, and explains why the GUIBERSON patented flexible cupped rubbers give an increasingly tight seal against casing or tubing wall as pressure increases. Fluid pressure is the greatest force present, in swabbing—and this pressure works with the GUIBERSON cupped rubber to increase its effectiveness. It works against solid rubbers, to force a passage past them.

The GUIBERSON cupped rubber has another basic advantage. It does not depend upon a tight, "squeezing" fit, in the pipe. Running in, the fluid easily presses the cup edges inward, and by-passes the cups. Thus this swab runs in more easily and faster than any other, and does not hang. Nor do pipe irregularities tear the cups.

These basic advantages have made the GUIBERSON Swab the leader. It does 90% of the world's swabbing, and does it economically, for its yielding rubbers have long life. For full details see The Composite Catalog or your supply store.

THE GUIBERSON CORPORATION . . . . . BOX 1106, DALLAS, TEXAS

Tulsa, Okla Kilgore, Tex. Kermit, Tex. Houston, Tex. Salem, Ill.
Newark, O. Denver, Colo.

Los Angeles: The W. R. Guiberson Co. Export: I. Frank Brown, New York City

BETTER BE SAFE THAN SORRY

GUIBERSON

The stress distribution in a lap joint can be improved by using concave beads as shown in the photoelastic analysis of the stress distribution in a joint of this type. (Fig. 3.) On comparing the stress analysis of this joint with that of the joint shown in Fig. 2, it will be noted that the stress distribution at the ends of the welds is much less severe in this bead type, but the change did not remove all of the stress concentration at this point. Also, the parent material is still subjected to a combined bending and tensile stress, because the nature of its loading has not been changed.

A lap joint having only one concaved bead is the subject of the photoelastic analysis in Fig. 4. The analysis reveals that this type of joint has all of the defects of the former types of lap joints and, in addition, a very high degree of stress concentration at each end of the bead. Due to the low efficiency of this type of joint, it should not be used in any member subjected to a varying load.

The bending stresses existing in the parent material, outside of the joints, can be eliminated by using an offset or joggled lap joint as shown in Fig. 5. The results of a photoelastic analysis of this joint are shown in Fig. 6. This analysis indicates that the stress condition existing in the parent material, outside of the joint, is pure tension, and that the stress is adversely concentrated in the bent portion of the joint. If the bent portion of the joint were completely filled with weld metal, this condition would be eliminated, but the stresses would be concentrated at each end of the hump created by the offset in the parent material.

The ideal type of joint for joining two parallel, in-line pieces is the butt-type joint, as shown in Fig. 7. As a joint of this type has the same thickness as the pieces it joins together, it places no obstructions in the path of the stresses and therefore it does not cause any concentration of stresses around the weld. If properly made, a joint of this type will develop the full strength of the parent material under varying loads.

As the ideal butt joint is rather expensive to produce, it is not a common type of joint and a modified form of it is usually used. This modified form is the reinforced butt joint shown in Fig. 8. The results of a photoelastic analysis of this type joint are shown in Fig. 9. This analysis indicates that only a very slight amount of stress concentration exists in a joint of this type. The type of joint is satisfactory in most instances, but it is not equal to the ideal butt joint.

The butt joint when not properly made loses some of its advantages. The amount of this loss will depend on the nature of the error existing in the joint. An apparently perfect butt joint having lack of penetration, i.e., not welded completely through, is shown in the photoelastic analysis of Fig. 10. This analysis indicates that the stresses are concentrated at the ends of the hole. The exact nature of this stress concentration will depend on the shape of this void space; if it has sharp corners, the stress concentration may be very adverse. If a joint of this type were subjected to a varying load of high intensity, it would fail through the weld.

Another type of lack of penetration is shown in photelastic analysis shown in Fig. 11. In a joint of this type, the stresses are highly concentrated around the unfused notch, because it disrupts the flow of the stresses at this point. A butt-type joint containing this type flaw would fail through the weld if it were subjected to a varying load.

The efficiency of a butt joint will be materially decreased if it is undercut as in the photoelastic analysis shown in Fig. 12. This analysis indicates that the stresses are concentrated at each of the two notches. The magnitude of this concentration will depend on the shape and depth of these notches. If a joint of this type were subjected to a load of varying magnitude it would fail through one of the notches.

Excessive reinforcement with overlap will decrease the efficiency of a butt weld to a varying degree. A typical example of this type of butt weld defect is shown in the results of a photoelastic analysis of this joint as shown in Fig. 13. This analysis indicates that the stresses are mildly concentrated in the corners of the weld, and that the excess weld metal carries only a very small portion of the load. The adversity of this type of weld flaw will depend on the sharpness of the corners between the weld cap and the parent material, as a sharp corner at this point will cause more stress concentration than a corner with less sharpness.

Another type of joint that is widely used in welded structures is the tee joint. A typical example of this type of joint having convex beads is shown in the photoelastic analysis. (Fig. 14.) This analysis indicates that the stresses are concentrated at each corner of the weld bead, and that the stress distribution in the leg section of the tee is rather adverse. If a joint of this type were subjected to a varying load of high intensity, it would fail at the base of one of the welds.

The stress distribution in the tee joint can be improved by using concave weld beads as shown in Fig. 15. Fig. 16 shows the results of a photoelastic analysis of this joint. Comparing the results of this analysis with the analysis of the joint having convex beads reveals that the use of concave beads improved the stress distribution in the joint and therefore increased the efficiency of the joint materially.

The effect of lack of penetration on the stress distribution in a tee joint is very similar to its effect on a butt joint. The results of a photoelastic analysis of a tee joint having lack of penetration is shown in Fig. 17. This analysis shows that lack of penetration in a tee joint produces some concentration of the stresses and reduces the efficiency of the joint accordingly. The amount of the loss in efficiency will depend on the nature of the void, because its shape will determine the amount of stress concentration induced in the joint.

The efficiency of the tee joint decreases materially when it is welded on one side only, as shown in the stress distribution analysis in this joint. (Fig. 18.) The analysis indicates that the stresses are very highly concentrated at the inner edge of the weld, as the bands are concentrated at this point. When a joint of this type is used, this stress concentration must be considered, if the joint is to be successful when subjected to a fatiguing load.

This method of analyzing stress distribution can be applied to an entire element of a machine with the same ease that it can be applied to a joint used in the element. It has been used to improve the stress distribution in the notched slide bar that is used to hook on and off wells pumped by rod lines.

These studies of stress distribution verify the rule that the stresses in a piece of material tend to flow in a straight line, and that any change in the section of the material carrying the load will tend to concentrate the stresses in the material at that change in section. A gradual change in section will have less adverse effects on the flow of the stresses than a more abrupt change in section. A good criterion to use to evaluate a joint or a structure is to visualize how water would flow through it. If water would flow through it freely and without eddies, stresses should flow through it without any undue amount of concentration. If water would not flow through it freely and without eddies, the stresses will not flow through it freely, and they will be concentrated where the flow of the water would be restricted and disturbed.

P 615.635.4

Location and Installation of Ground Beds[1]

Horizontal or vertical ground beds may be used depending upon whether soil varies in character and in seasonal moisture content

By D. F. BALL
Assistant Superintendent, Telephone and Telegraph
United Gas Pipe Line Company

THE purpose of this paper is to present a non-technical discussion of a few of the more important items to be considered in the proper location and installation of a ground bed.

The selection of test instruments should first be considered carefully. In the past a great many different methods have been used to measure the resistance of the soil. Some of the methods, such as the d-c. method requiring a reliable source of d-c. energy, involve the transportation of a considerable amount of equipment. The results obtained by the d-c. method are not always reliable, due to polarization at the test rods and to stray currents that may be present in the vicinity, the effects of which can be overcome only by rapid reversal of current to the electrodes.

The a-c. ammeter-voltmeter method is not feasible, because in most cases the tests must be made in localities where alternating current is not available.

Another popular method involves the use of the Shepherd canes or rods and a milliammeter calibrated directly in ohms per cu. cm. This method is satisfactory except that it is rather difficult to test to an appreciable depth without drilling a test hole and bringing samples to the surface for measurement.

In selecting a method it is suggested that the a-c. fall-of-potential method derived from formulas (by Wenner) be used. A modified version of this method is contained in the megger ground-resistance tester. The principle of this set is based on the use of four electrodes spaced equidistant; an alternating current is introduced into the soil through the outer or current electrodes, and its values are recorded simultaneously with the fall of potential across the inner electrodes. The values are measured by a direct-reading ohmmeter. The resistance measured is that of the portion of soil around the inner, or potential, electrodes to a depth approximately equal to the spacing of the electrodes. There are a number of other combinations that may be obtained using this meter and it is believed to be the most flexible for all types of soil resistivity measurements encountered in the field.

D. F. BALL

has been on the staff of the United Gas Pipe Line Company since 1929—Until a year ago he was equipment supervisor, now being assistant superintendent of telephone and telegraph—Prior to his connection with United he was with the Southwestern Bell Telephone Company—His home is in Houston, Texas.

In most cases, when a great number of leaks are spotted on a line, the soil in the vicinity will be of low resistance compared to the other sections in which no leaks have occurred. It is at such points that cathodic protection units will usually be installed and consequently the definite area is known in which a ground anode will be required.

Using the megger test set, the area may be surveyed, giving most attention to the low spots, where lowest-resistance soil will usually be found. This is not always true, however, as ground beds have occasionally been situated on hillsides or on the edges of swamps where the resistance was found to be much lower than in the swamp or creek bed.

When the site of the ground bed is selected, the average earth resistivity is taken to the depth that gives the best indication, and this is used as a basis for calculating the size of the anodes and the depth to which they will be placed. Several curves are available for the calculation of these resistances[2].

Due to the fact that in most instances soil resistivities vary greatly with the depth, the resistance cannot be exactly determined, but an approximate value can be obtained that will be satisfactory.

After the value of one rod has been determined, it becomes necessary to decide on the number of rods to be placed to obtain the desired resistance in the bed.

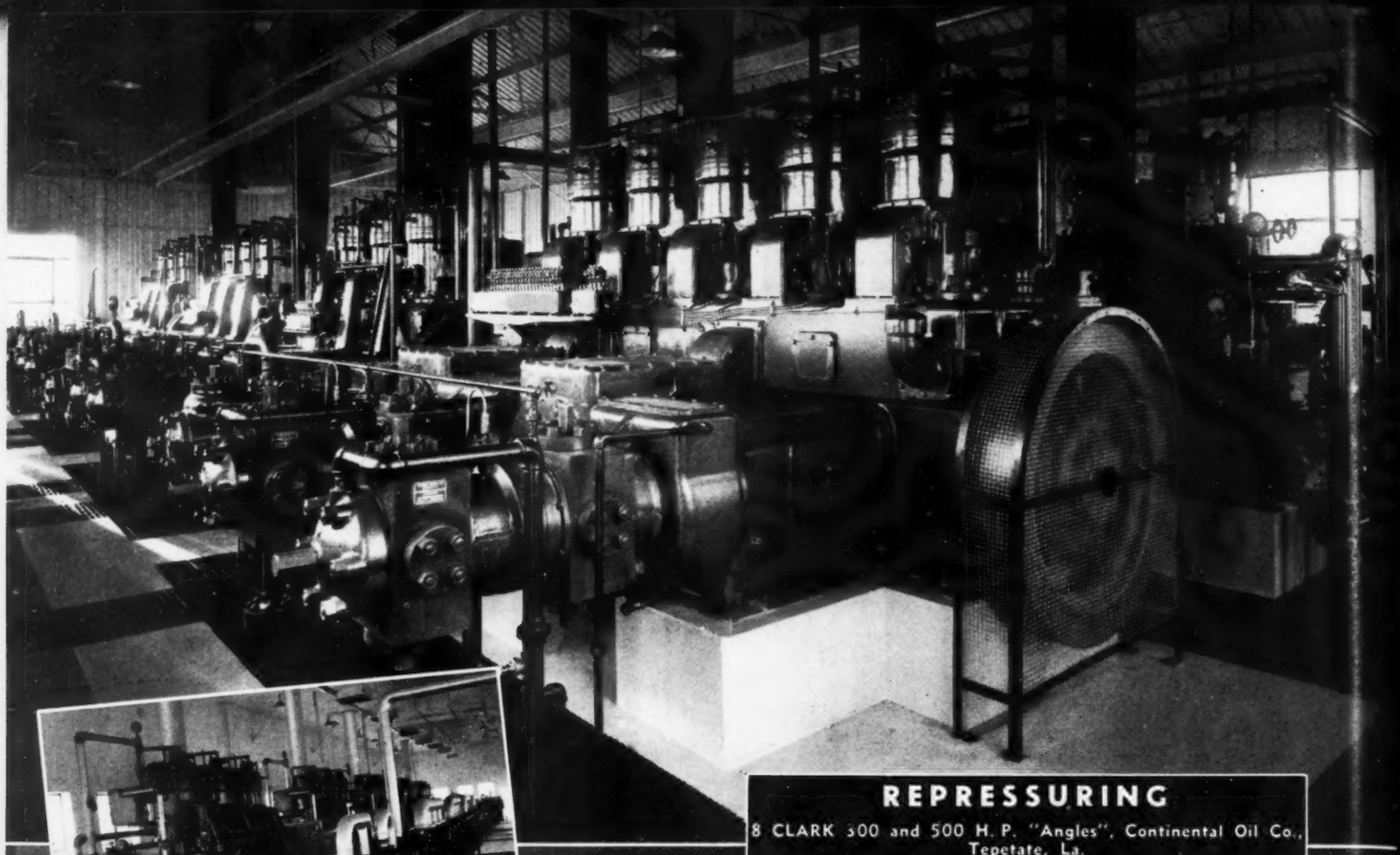
The spacing of these rods plays a very important part in the efficiency of the ground bed. If the spacing is close, the effective resistance of the ground bed will be impaired; if it is too far, a useless waste of cable is necessary to connect the anodes in parallel.

By several measurements it has been determined that a 4-in. pipe in soil having a resistance of 1270 ohm per cu. cm. has a total resistance area of 13 ft. If this size pipe were used, it would be necessary to place the pipes 26 ft. apart to decrease the resistance of the ground bed in proportion to the number of rods installed. The distance apparently does not increase exactly in proportion to the diameter of the pipe used. In the same soil an 18-in. pipe was tested, and it was found that the spacing was approximately 25 ft., resulting in a total spacing of 50 ft. between pipes.

Recent developments by several companies have indicated that it is seldom necessary to place the ground

[1]Paper presented at Oil-World Exposition, Houston, Texas.

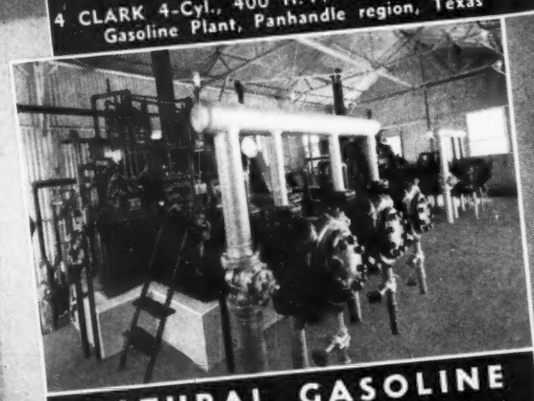
[2]B & S Paper No. 108 by O. S. Peters and W. R. Schneider, Pacific Gas and Electric Company.



REPRESSURING
8 CLARK 300 and 500 H. P. "Angles", Continental Oil Co., Tepetate, La.

BUTANE PLANT
5 CLARK 300 H. P. "Angles" used for producing Butane, Shamrock Oil & Gas Co.

NATURAL GASOLINE
4 CLARK 4-Cyl., 400 H. P. "Angles" in Natural Gasoline Plant, Panhandle region, Texas



NATURAL GASOLINE
2 CLARK 300 H. P. "Angles," Eason Natural Gasoline Plant, Crescent, Okla.

"ANGLES" NOW
ALL TYPES O

Offer Highest Efficiency

CLARK Right-Angle Compressors have now definitely proved their high efficiency in all types of compressor service. On these pages are shown installations in Natural Gasoline Plants, a Repressuring Plant, a Recycling Plant, a Polymerization Plant, an Oil Pipe Line Station, a Gas Booster Station, a Butane Plant.

The CLARK "Angle" offers all of the advantages of the famous CLARK "Super-2-Cycle" Horizontal Compressor, including its rugged simplicity of design. But the "Angle" has introduced 4 substantial money savings:

1. It is shipped assembled, reducing transportation and erection costs.

CL

RECYCLING
4 CLARK 600 H. P. "Angles," Corpus Christi Corporation, South Texas

M PROVEN IN
S OF SERVICE

y —Yet Save 4 Ways!

2. It requires smaller foundation, less floor space, smaller building.
3. It effects savings of over one-third in fuel, due to CLARK Fuel Injection and 26% excess scavenging air.
4. Simplicity and rugged construction result in lowest maintenance.

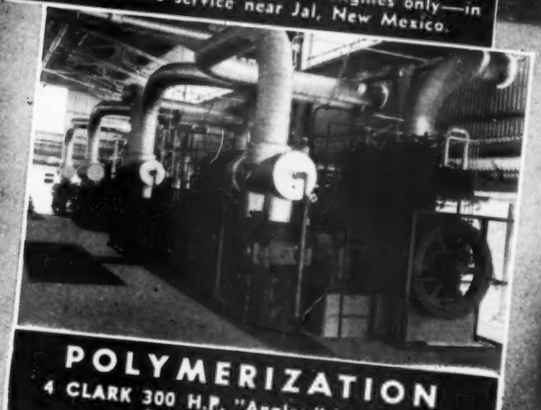
The CLARK "Angle's" spectacular success has been due to these and other exclusive advantages. You should investigate.

CLARK BROS. COMPANY . . OLEAN, NEW YORK, U. S. A.
Export Office: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla., Houston, Texas, Chicago, Ill., Boston, Mass. (131 Clarendon St.) West Coast Office: Smith-Booth-Usher Co., Los Angeles, Cal. Foreign Offices: 72 Turnmill St., London, E. C. 1; 4 Str. Gen. Poetas, Bucharest, Roumania

ARK

GAS BOOSTING
5 CLARK 600 H. P. "Angles," Wilmot, Ark. Booster Station, Memphis Natural Gas Co.

OIL PIPE LINE
2 CLARK 300 H. P. "Angles"—engines only—in oil pipe line service near Jal, New Mexico.



POLYMERIZATION
4 CLARK 300 H.P. "Angles," in a Thermal Polymerization Plant.

bed at great distances from the pipe line. In most cases a distance of 200 ft. is ample, and in the case of small pipes, or distributed anodes parallel to the pipe line, this can be greatly reduced. This results in a considerable saving in cable to complete the circuit.

There apparently is no definite shape or form of beds that is outstanding, just so long as the correct spacing of the pipes is not less than the specified distance.

Tables are also available for the calculation of horizontal beds and are very similar to those previously mentioned.

There seems to be no particular advantage in the choice of either a horizontal or vertical ground anode when the soil resistivity is uniform to a given depth.

There are, however, some disadvantages to each that should be mentioned. In the vertical ground bed, as has been previously stated, it will pass through a number of soil strata, some of which will have a lower resistance. It is possible that in time these pipes would dissipate current and, therefore, metal more rapidly in these strata and as a result a portion of each pipe might be lost if the low resistance stratum was near the surface of the ground. In the horizontal bed there is a possibility that because of seasonal variations, the resistance of the bed would not remain constant, increasing in the dry and lowering in the wet seasons.

If it seems unlikely that a good contact can be obtained between pipe and soil, it may be treated with sodium or calcium chloride. Care should always be exercised in using this method, in that a great amount of time and material can be wasted if the work is not done properly. If top treatment is attempted in plowed fields, a resulting loss of vegetation may occur, involving a damage suit.

In the case of vertical pipes, they should be perforated before installation, and then treated from the inside of the pipe.

Horizontal pipes should be perforated and risers brought to the surface, so that salt can be washed into the pipes and allowed to seep into the soil gradually.

New Laboratory For Testing Motor Fuels and Lubricants Under Operating Conditions

THE new automotive laboratory recently completed at the Point Breeze, Philadelphia, refinery of the Atlantic Refining Company provides a graphic illustration of the extent to which the petroleum industry is directing the facilities of scientific research to the constant testing and improvement of products used by the motoring public.

Of concrete block construction, the new laboratory has a floor space of approximately 10,000 sq. ft., and contains advanced equipment for testing motor fuels and lubricants under road and service conditions. Severe winter operating conditions can be simulated by means of a refrigeration and blower system that can supply cold, dehumidified air at a velocity as high as 70 miles an hour to the chassis dynamometer test room, an adjacent cold room for engine tests, and a third cold room for small test equipment such as spring lubricant test machines, wheel bearing test machines, and other lubrication test devices. The temperature of each of these rooms can be varied from minus 20°F. to 120°F. The refrigeration is supplied by two 50-hp. and one 15-hp. automatically-controlled compressor units having a daily ice-making capacity of 88 tons at an atmospheric temperature of 60°F.

The performance of fuels and lubricants in passenger cars and trucks can be tested under these widely varying temperatures and wind velocities, and under similarly widely varying degrees of load, in the chassis dynamometer test room. The car or truck is blocked in position with the rear wheels resting on a pair of wide rollers flush with the floor of the room. As the rear wheels are driven by the engine, the rollers in effect provide an endless highway under the vehicle. The shaft to which the rollers are attached is direct-connected to a 150-hp. electric dynamometer situated in an adjacent room that makes it possible to measure the power generated by the test vehicle.

An unusual feature of the chassis dynamometer test room is the fact that in place of the dynamometer control panel mounted permanently on the wall, a modified form is contained in a portable box about the size of a small suitcase that can be placed in the car beside the driver and operated by him. The driver also has beside him the remote control instrument that controls the speed of the cold air blower by means of a hydraulic coupling. Inasmuch as loads can be applied against the rotation of the rollers by means of the dynamometer, the driver can simulate any grade usually encountered, and by varying the speed of the air blower he can vary the velocity of the air blast against the radiator of the car so that temperatures encountered in the test equipment are comparable to those found under actual service conditions.

Although the chassis dynamometer test room is large enough to accommodate the largest truck, the insulated doors separating this room from the adjacent cold room for engine tests can be thrown open to provide additional space for accommodating any abnormally large vehicle. Primarily this adjacent cold room is intended for starting tests and other tests of fuels of varying volatilities and oils of varying viscosities, with engines operating at low temperatures. The test engine is placed on a permanent foundation and can be connected, by a shaft extending through the wall, to a 300-hp. electric dynamometer in the next room.

The room in which the 300-hp. dynamometer is installed also has engine foundations, the result being that an engine connected to the dynamometer can be mounted either in the adjacent cold room or in the room where the dynamometer is installed. Tests on large gasoline truck engines and Diesel engines are made in this room. Two other dynamometer rooms contain, respectively, a 75-hp. electric dynamometer and a 45-hp. electric dynamometer. Either of these rooms may be used for cranking tests and frictional hp. runs on the smaller passenger car engines. A third room contains six hydraulic brake dynamometers, each capable of absorbing more than 200 hp. and designed for speeds to 4400 r.p.m. Tests for lubricating oil stability, engine wear, and evaluation of experimental motor oils are made here.

Tests of the octane, or anti-knock, value of the refinery's products, of blends, and of experimental fuels, are conducted in the knock-testing room on three standard knock-testing engines.

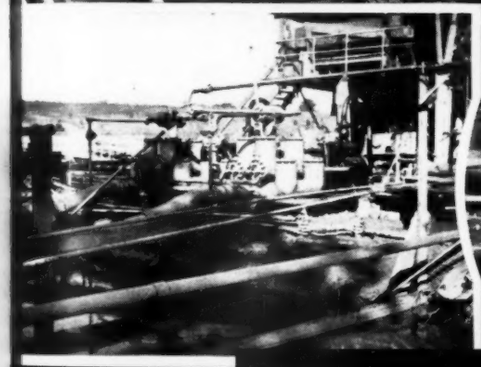
Preliminary tests of experimental lubricants are made on a battery of small single-cylinder test engines installed in another room known as the general laboratory room.

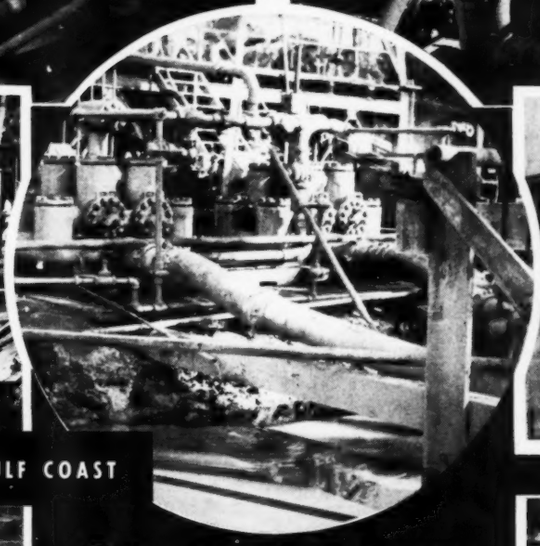
A FAMILIAR SIGHT
IN THE DEEPER DRILLING AREAS

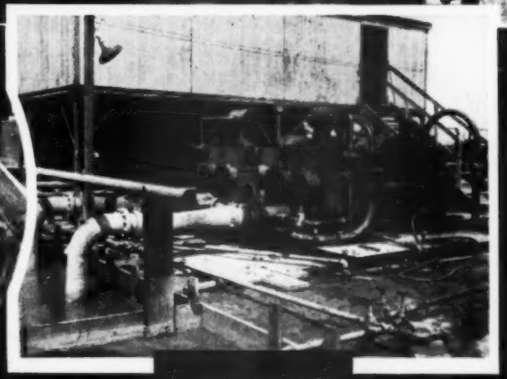
IDEAL STEAM SLUSH PUMPS

"Reg. U. S. Pat. Off."

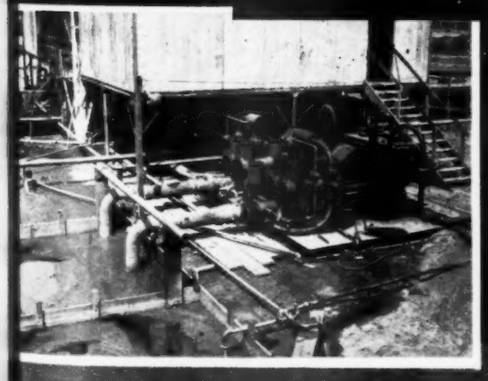
(15½ x 8½ x 20)



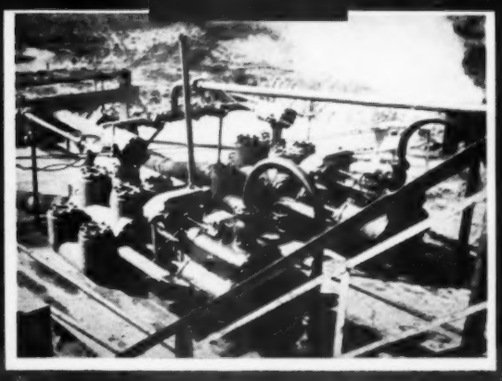




LOUISIANA GULF COAST



RIO BRAVO



● Have you noticed the frequency of Ideal 15½ x 8½ x 20 Steam Slush Pump installations in the deeper drilling areas?

Operators know that they can depend on them for good performance under all conditions.

NATIONAL

THE NATIONAL SUPPLY COMPANY

EXECUTIVE OFFICES: PITTSBURGH, PA.
GENERAL SALES OFFICE: TOLEDO, OHIO

DIVISION OFFICES: FT. WORTH, TEXAS;
TULSA, OKLA.; TORRANCE, CALIF.

The Distillation Process of Natural Gasoline Extraction

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Development of rectifying and refluxing processes provided exacting control of natural gasoline distillation

By ROY W. MACHEN
Hamman Exploration Company

A COMPLETE cycle in distillation consists of two separate and distinct steps, vaporization and subsequent condensation, or cooling of the various fractions to the desired final temperature.

Simple distillation is essentially a "weathering process". The routine Engler distillation in the laboratory is an example of simple distillation. In this method, the vapor is released and removed from contact with the liquid as fast as it forms. As the temperature of the liquid increases, more vapor is formed, and the remaining liquid continuously contains less of the more volatile liquids.

Flash distillation is accomplished by heating a liquid of a given composition to a constant temperature and holding the liquid and vapor together until they are introduced into the column on the feed plate. Immediately as the liquid-vapor stream is introduced, the vapors are flashed-out, i.e., released overhead, and the liquid that remains is continuously withdrawn as "bottoms".

Fractionation is essentially a number of distillations performed successively in a column containing trays. The trays permit a succession of vaporizations and condensations to take place until the desired amount of separation has been obtained.

There are two objectives in natural gasoline plant distillation:

1. To fractionate the rich oil to obtain the desired gasoline fractions.

2. To reduce the rich oil again to lean oil so that it may be recycled through the absorbers at as near its original constituency as possible.

Because marketed products today must conform to precise specifications, the petroleum industry has adopted the principle of rectification in hydrocarbon distillation.

Natural Gasoline Distillation

The distillation process in a natural gasoline plant is best explained by tracing the various steps that are involved, beginning with the rich oil leaving the absorbers. In the absorbers, the original lean oil has been enriched by gasoline constituents and, upon leaving the absorbers, then enters the heat exchangers on its way to the still as "fat," or rich oil.

ROY W. MACHEN
received a bachelor's degree from Oklahoma City University in 1927—Employed for six and one-half years by the Peppers Gasoline Company as refinery clerk, refinery and gasoline plant chemist, and gas engineer — The last five and one-half years have been spent in the service of various independent refining companies as gas engineer, operator in high-pressure gasoline plants, refinery construction engineer, and superintendent of refinery operations—He is a registered petroleum and natural gas engineer.

Although the absorbed gasoline fractions are groups of complex mixtures, the rich oil shall be considered here as having only two components—the absorption medium and the absorbed fraction.

The rich oil is removed from the absorption system either by pumping or by differential pressure between the absorbers and the still. The cold rich oil enters the heat exchangers at the bottom, and passes through the tube bundle in each exchanger successively to the top. In the exchangers, the rich oil has picked-up 150 to 200 deg. (F.) of heat from the hot oil that, after being discharged from the still base, has entered the shell surrounding the tube bundle of the top exchanger and progressed downward through the exchangers in series to be discharged from the bottom exchanger into the lean oil surge tank. From the exchangers the rich oil enters the bottom of the tube bundle contained in the preheating section. The rich oil is diverted into the top section of the tube bundle at the rear end and leaves the preheater 60 to 100 degrees hotter to enter the evaporator column or section, as the case may be, on the feed plate near the top. The oil in passing through the metal tubes within the preheater obtains its increase in heat by transfer through the thin tube walls from the live steam that is supplied continuously to the surrounding tubular shell. The condensed water in the lower part of the shell is trapped and the condensate is returned to the boiler feedwater tank.

The distilling column is composed essentially of two sections—a steam evaporating or reducing section and a fractionating or rectifying section. These sections may be superimposed one on the other or may be set independently. If the two sections are unitized, the unit is called a combination tower or still. If they are set independently, one is termed the evaporator and the other is usually called the dephlegmator. In the latter case, the gasoline is "flashed" or vaporized from the rich oil in the evaporator and the lean oil carry-over is fractionated or "knocked back" to the base of the dephlegmator.

The column or tower is properly sized in diameter and height to provide for a maximum lean-oil circulation and gasoline production. Intimate contacting of the upgoing stream of vapor from the heated oil with a descending stream of liquid, is provided by the arrangement of trays, bubble caps or their equivalent, and downspouts. The number of trays that will be necessary depends upon the extent of the separation desired between the lean oil and gasoline and the kind of absorption oil that will be used.

Evaporation

In the evaporator, the rich oil flashes immediately when released on the feed plate. That is, the greater portion of the gasoline and a small part of the more volatile constituents of the lean oil are released in vapor form. It must be clearly understood that at this point no clean-cut separation occurs, as a

small percent of lean oil has also been vaporized. Likewise, there has been a small portion of the gasoline fraction retained by the lean oil as it drops to the trays below.

The gasoline vapors plus the small volume of lean oil and steam rise from the feed plate into the rectifying section if the still is of unit type. If the evaporator and dephlegmator are set independently the vapors pass overhead through a vapor line from the evaporator and enter the dephlegmator just below the bottom tray, which is about 5 ft. from the base of the column. The lower space in the dephlegmator is used as a reservoir for the heavy fractions not desired in the finished product. Most of the water condensed from the steam that is continuously introduced into the evaporator section also accumulates in this reservoir. If the still is of unit type, there will be a water tray in the lower part of the dephlegmator section, from which the water will be drained constantly by means of a trap. The "knock back" or reflux (hydrocarbon condensate) that accumulates in the dephlegmator (when the sections are separate) is held at a constant level and the surplus is returned to the base of the evaporator by means of an ejector.

Rectification

In either the unit or two-element still, the rectifying of the gasoline vapors is essentially the same. The vapor as it rises from tray to tray to the top of the fractionating section is brought into intimate contact with a descending stream of liquid. The depth of the liquid on the trays is such that the slots in the bubble caps are covered and a liquid seal is obtained. In this way, the rising vapors are forced to contact the liquid on each tray before rising to the next tray above. The liquid on each successive tray is different in composition. The higher the tray or deck is from the feed plate, the richer the liquid is in lighter components and the poorer it is in the heavy constituents. As the liquid progressively becomes more volatile the farther removed it is from the feed plate, so does the temperature at each successive plate become less.

At the same time, the liquid dropping down the tower from the feed plate becomes heavier with the high-boiling-point material and poorer in volatile fractions until it falls into the base of the evaporator as "bottoms" ready for removal through the heat exchangers to the surge tank. From the surge tank, the stripped oil is pumped through the cooling coils to the absorbers to begin another cycle. As the liquid progresses from tray to tray down the evaporating section, the temperature will decrease as it did in the rectifying section. Steam heating elements are provided, however, in many installations so that the downcoming oil may be reheated, and often the oil leaving the base of the still is hotter than it was when it entered on the feed plate.

Refluxing

There is a certain amount of condensation and subsequent overflow to the tray below from each plate in the tower. The top deck, however, does not have enough normal condensation to provide the "head" necessary for the continuous flow of liquid down the column. This deficiency is remedied by the introduction of a portion of the overhead product back into the tower on the top plate as "reflux."

This reflux may be of varying composition, depending on the type unit being considered and, in a great many cases, on outside factors such as cooling-tower capacity, water supply, wind velocity, and, of course, the relation of the plant normal capacity to actual plant load. The quantity of reflux, or the reflux ratio, depends on the degree of separation desired and the endpoint desired in the raw gasoline.

Theory of Fractionation

A state of equilibrium may exist between a liquid and a vapor if the temperature or pressure is fixed. When such a state of equilibrium exists, the quantity of liquid that enters the vapor state is equivalent to the quantity of liquid resulting from vapor condensation.

The tendency of a liquid to change to a vapor is termed vapor tension. The vapor tension of a liquid becomes equal to the vapor pressure when a state of equilibrium has been attained and evaporation will take place only when the vapor pressure of a liquid is less than the vapor tension.

As the vapors rise from one tray to another, the heavier components in the vapor condense when they contact the liquid on the deck above. This condensation imparts heat to the liquid on the tray and this added heat disturbs the existing tendency toward equilibrium. Of necessity, the portion of lighter fractions contained is vaporized and rises with the uncondensed vapors to the tray above to undergo another distilling process. A similar series of condensations and vaporizations occurs on each deck, giving the effect of a separate and distinct distillation each time it happens, the heat for distillation being provided by condensation of ascending vapors.

The liquid surplus from each tray overflows to the deck below by means of a downspout. This liquid is richer in lighter constituents than the liquid with which it comes in contact and is, of course, slightly cooler in temperature. The descending liquid is consequently stripped of its lighter components, leaving only the heavier portions on the lower deck; as a result, the liquid on each tray is more or less in a state of equilibrium.

The major portion of the gasoline is immediately released from the heavy fractions of absorption oil at the feed plate. There is a small portion, however, still contained in the liquid that pours down from tray to tray into the base of the column. The evaporator section, therefore, has only one main useful purpose—the removal of the last traces of the volatile components.

Steam Is Used

The practice in an average plant has been to introduce live steam at the bottom of the still directly into the oil. An economical practice that aids considerably in decreasing the boiler load is to introduce exhaust steam from the operating pumps and add live steam only in the amount necessary to obtain the desired stripping. The steam introduced in the still base does two things: 1. The partial pressure of the hydrocarbons is lowered. This consequently lowers the boiling point and permits the stripping of the heavier gasoline fractions from the oil as it drops down from the feed plate. 2. The evaporation surface is increased because of the agitation of the oil surface and thus increased separation efficiency is attained.

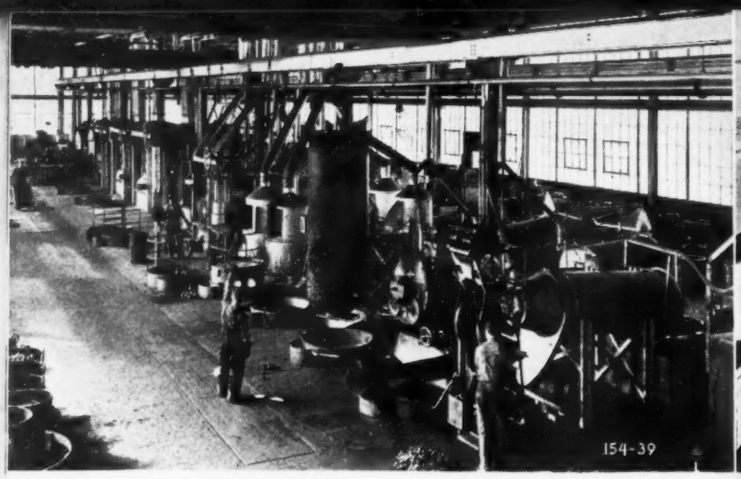
Concerning the amount of steam necessary, it is usually considered that approximately 0.2 lb. per gal. of oil circulation, or 200 lb. per 1000 gal., is sufficient at 40-lb. still pressure.

That portion of the steam that goes-over with the gasoline vapors will be condensed in the primary coils and drop into the reflux accumulator to be removed and returned to the boiler feedwater system or dropped to the cooling tower basin or to the sewer.

The primary gasoline condensate will be used as reflux; the surplus and the uncondensed vapor will go to the secondary coils for further cooling and condensation, and thence to the "surge" or make tank.

Pressure is held constant on the distillation system by means of a back-pressure regulator. The surplus vapors released from the top of the make tank are either recycled through the low-pressure absorber system or go to a compressor to be returned to the main absorption system.

The gasoline is now ready for stabilization.



Jeffrey heat-treating department, equipped with the latest devices for proper treatment of the finest alloy steels used in our oil well chains.

Precision methods in the Jeffrey plant start with the receipt of raw material. All chain steel is subjected to most rigid chemical, physical and micro-graphic analysis.

Jeffrey No. 124 Rotor Chief for average to deep drilling. It has 4.063 inch pitch and listed ultimate strength is 130,000 lbs. Also made in A.P.I. No. 3 size with 3.075 pitch and listed ultimate strength—60,000 lbs.

ROTARY CHAINS

with a SCIENTIFIC BACKGROUND

Oil-well-chain manufacture here at Jeffrey begins with the selection of the finest alloy steels adaptable to chains . . . follows through with rigid chemical analysis, proper heat treatment, and precision manufacturing methods on the latest improved machine tool equipment.

Such a scientific background (see illustrations) for Jeffrey Rotary Chains is your assurance of getting accuracy of fit, smoothness of bearing surface, maximum strength and hardness for minimum weight, balanced construction, and resilience to absorb shock . . . all factors which give the added life you have a right to expect from a superior product.

There is *economy in quality* as you will soon learn if you use Jeffrey oil well chains, backed by over 60 years of chain-making experience.

Jeffrey Devil Dog rotary chain, A.P.I. No. 4 designed for the deepest drilling operations. Pitch is 4.063 and listed ultimate strength—170,000 lbs. Also made in A.P.I. No. 3 size with 3.075 inch pitch and listed ultimate strength of 75,000 lbs.

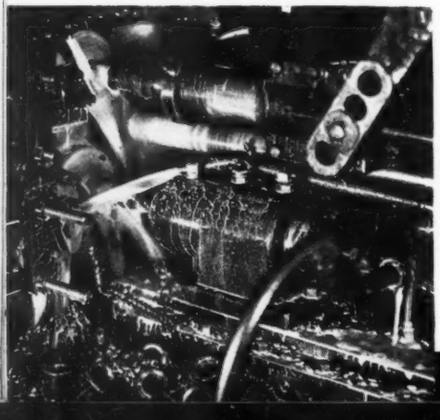
Jeffrey Ranger chains are a comparatively new A.P.I. standard, designed for high speeds and heavier loads. The No. D-312 with 3.125 inch pitch is shown above. 230,000 lbs. listed ultimate strength.

THE JEFFREY MANUFACTURING CO.

897-99 North Fourth Street, Columbus, Ohio, U. S. A.

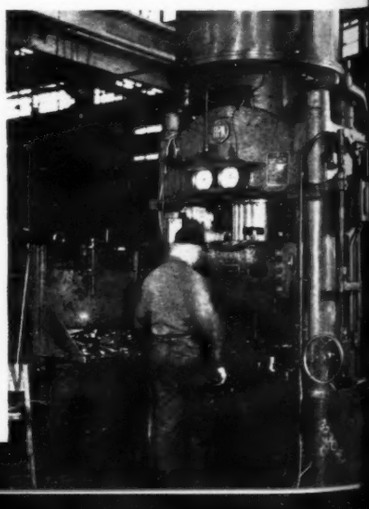
Cable Address: "Jeffrey-Columbus"

In Texas: 6358 Auden Street — Houston



Rollers and thimbles on Jeffrey rotary chains are turned from solid bars on high speed automatic machines. Each piece is an exact duplicate of the other, making a perfect fit with neither play nor binding.

SEND FOR BULLETIN 708



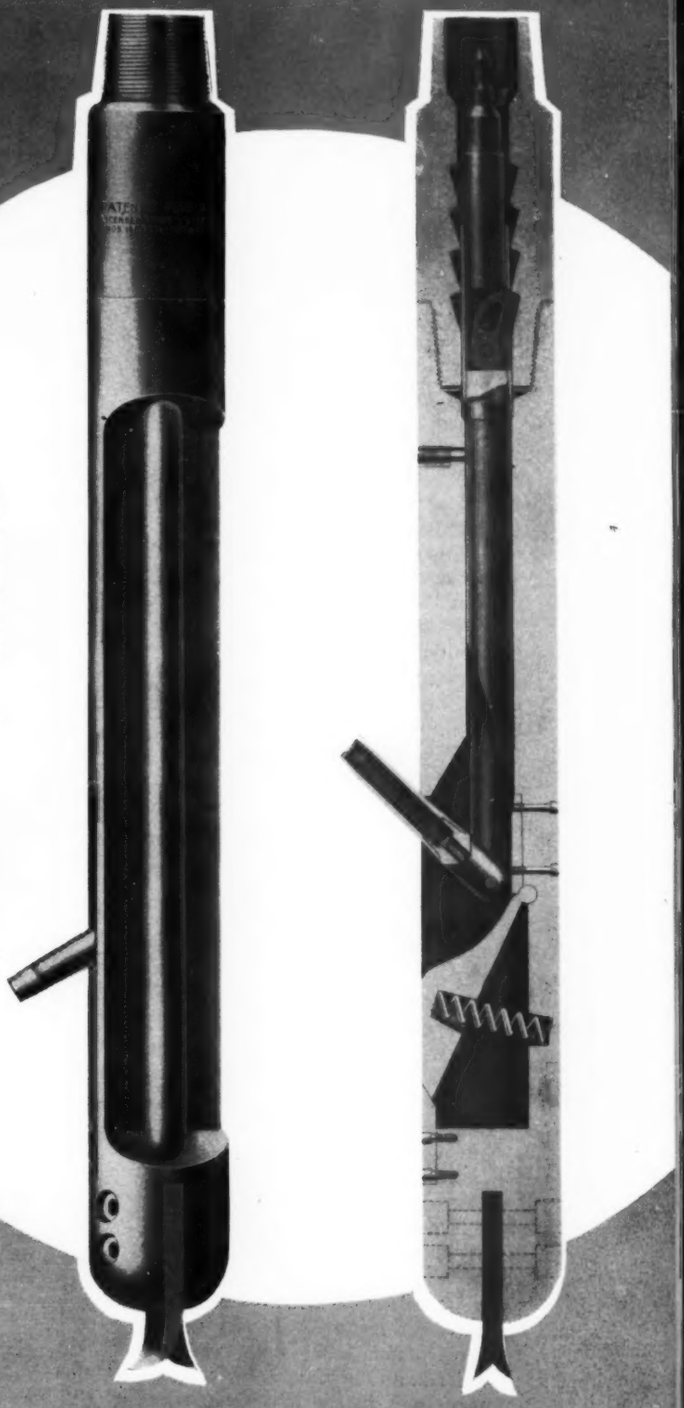
Chain side bars are offset under tremendous pressure on giant hydraulic presses (right). Any deformations in the bars are removed and every bar is uniform and true.

SIDE WALL SAMPLES
THAT HAVE THE VALUE OF CORES!

HERE'S A REVOLUTIONARY METHOD THAT PERMITS DRILLING TO COMPLETION WITHOUT INTERRUPTION

The HOMCO SIDE WALL SAMPLER introduces a new era in drilling efficiency and economy. Briefly, here's what it means to you as an operator: It enables you to drill to the desired depth without the customary delay for continuous or even occasional coring. Upon completion, the hole is electrically logged for likely production levels and these formations then sampled by this truly revolutionary tool. It is run on drill stem, assuring you accurate measurements of formation depths. Samples are taken and recovered through drill stem in connection with a retractable wire line barrel, the core tube being deflected in a unique manner out into the wall of the well bore. You get as many samples as you like on a single trip of drill stem. Samples are large enough (1¼" x 4" to 6" cores in 8½" to 12¼" holes and 1⅛" x 4" to 6" cores in 7½" to 8½" holes) to furnish a complete analysis of the formation sampled.

Operation is fast, safe and simple, as shown, and the tool is thoroughly field proven. Available in the U. S. on a service basis with trained operators . . . and sold for export. Write NOW for descriptive folder covering full details of design and operation.



Outside view shows core tube as it enters side wall upon downward movement of drill stem. Sectional view shows resting position after sample is taken, ready to be recovered after upward drill stem movement returns core tube to normal deflected position.

Patents applied for.
Licensed under U. S. Patents Nos.
1683642 - 1815661

HOUSTON OIL FIELD MATERIAL CO., INC. HOUSTON, TEXAS

HOMCO

CUTTING AND FISHING TOOL SERVICE
HOUSTON, TEXAS

BRANCH STORES: Beaumont, Kilgore, Victoria, Freer, Corpus Christi, Hebbronville, Alice, Odessa, Sam Fordyce, Texas; Shreveport, Lake Charles, New Iberia, Houma, Louisiana; Oklahoma City, Oklahoma

SALES OFFICES: Dallas, Texas; Tulsa, Oklahoma

Efficiently Serving an Industry With Honesty and Integrity

P 120.
P 912.110.120

South America Becomes Increasingly

By
WALLACE A. SAWDON
Pacific Coast and Foreign Editor

SOUTH America is becoming an increasingly important factor in the world's oil industry. In every country of South America except Peru, production for 1938 was greater than during the previous year and, as indicated on the accompanying graph, production for these countries has shown a steady increase during the last five years.

Venezuela is, of course, the biggest producing area in South America and with the additional pipe-line facilities recently completed or soon to be constructed, there is every reason to expect that its increase in production may be accelerated. This anticipated immediate increase in production from Venezuela will come both from the further development of fields that have been shipping oil and from fields that will start shipping because of the newly-acquired access to deep-water terminals. All the new areas are in Eastern Venezuela. The potentials of several of these areas that have been found productive are not yet known exactly. Stimulated by the new outlets, the development of several fields in the extensive territory north of the Oronoco River will probably keep attention focused on Eastern Venezuela during the ensuing year.

The Lake fields in Western Venezuela are by no means completely drilled-up and extensions are being made to these from time to time. Production from all but Lagunillas increased during 1938. Tia Juana is still a new area from the standpoint of active production and Badiaquero did not begin to ship oil actively until 1938. Exploratory work in both Eastern and Western Venezuela is being carried on continuously and test wells are now drilling in the Oronoco basin as far west as 140 miles from the Oficina field. Exploratory work in the Maracaibo Basin of Western Venezuela is confined, of course, by the mountains surrounding the Lake. One test to the south, however, is in the foothills. The coastal area between El Mine de Acosta field and Maracaibo has been rather well prospected and there are no test wells being drilled there at the present time. This does not mean, however, that attention may not be reverted to that territory between the coast and the mountains if information and conditions warrant.

Colombia, with its new pipe line from the Petrolea field in the Barco Concession to the seaboard, will undoubtedly continue to increase its production. Of great importance is the active exploratory work being conducted in Colombia. Not only are tests being drilled but considerable leasing activity during the last year has indicated that even greater efforts will be expended to make further discoveries of oil. Greatest activity at the present time is along the Magdalena Valley where several test wells are being drilled and in the Barco area along the Venezuelan border.

WALLACE A. SAWDON.

Pacific Coast and Foreign Editor of *The Petroleum Engineer*, has had more than twenty years' experience as an engineer and as a technical writer on petroleum engineering subjects—Two years ago he made an extended trip through South America, visiting the principal oil fields of Trinidad, Venezuela, Colombia, Ecuador, and Peru—The contacts made at that time and the general knowledge gained of operating conditions there have been of great assistance to him in the gathering and preparation of the material contained in the articles appearing in this section—The articles on the petroleum industry in the Argentine Republic were prepared by staff members of the Yacimientos Petroleiferos Fiscales, or Y.P.F., better known in this country as the Argentine Government Oilfields.

Peru, the first oil-producing country of South America, reached a peak in 1936 and its production has declined but little since that time. The recent discovery on the eastern side of the Andes at the headwaters of the Amazon has called attention to that vast area. Considerable leasing activity has been evident near Contamana in eastern Peru. Exploratory work also continues along the coast and future development may result on both sides of the mountains.

Trinidad, like Colombia, has had a consistently sharp increase in production since 1933. Wildcat areas being drilled lie not only in the territory south of the Central Range from which all oil production to date has come but also north of the mountains, where two wells are now being drilled. An active drilling campaign has been and is being conducted throughout the producing areas of the island and extensions to older fields as well as the development of newer ones have been important contributions to the total production. Trinidad is the greatest oil-producing colony of the British Empire and its importance is obvious.

Argentina's production increased but slightly during 1938, averaging approximately 1,400,000 bbl. per month. During 1939, the production rate exceeded 2,000,000 bbl. per month for a time and may be expected to maintain an average of approximately 1,800,000 bbl. per month. The areas of Argentina now productive or being explored actively extend over a distance of more than 1600 miles from north to south. Only one of these areas, Comodore Rivadavea, is on the coast but this area is producing more than 80 percent of Argentina's oil.

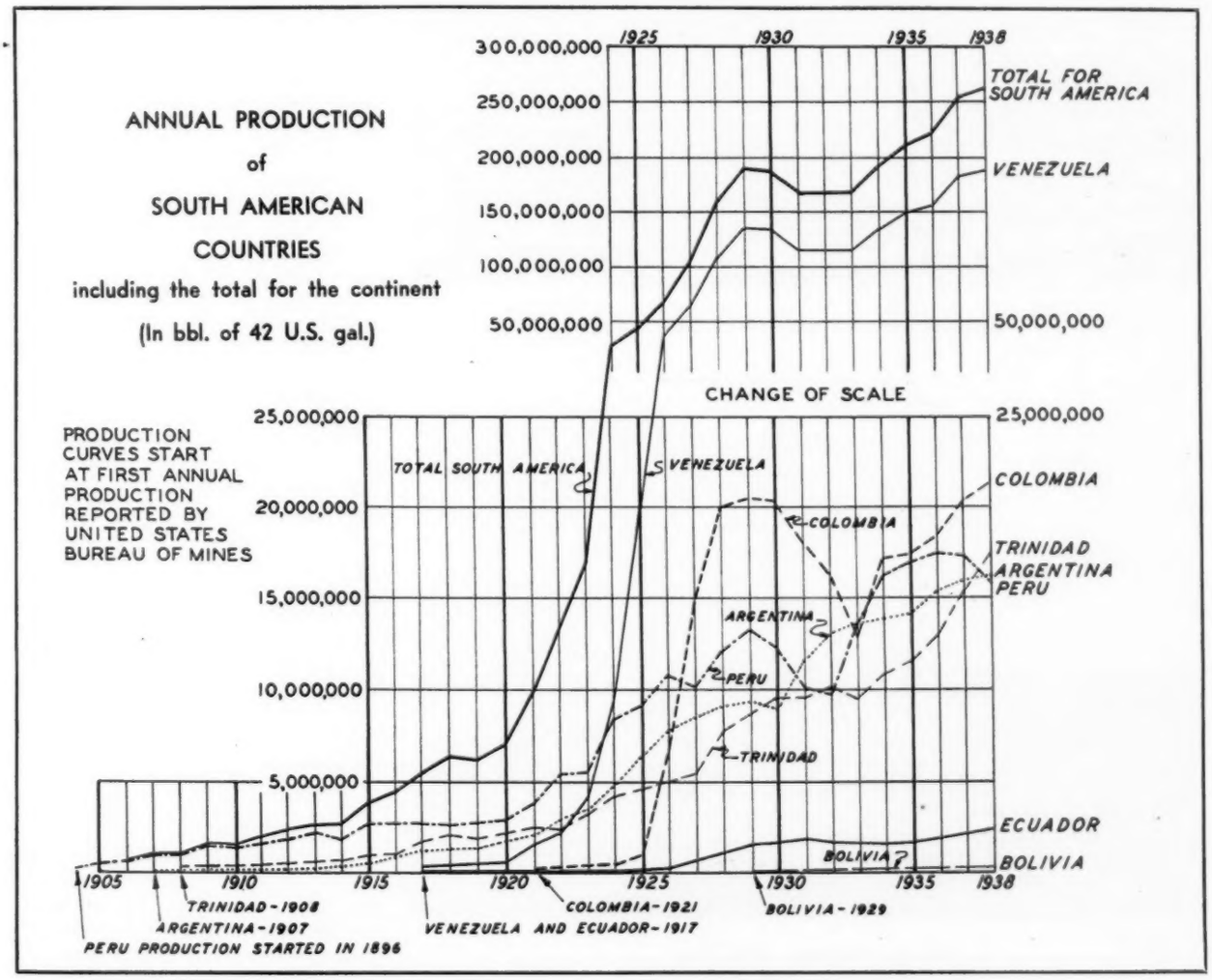
Important in World Petroleum Industry

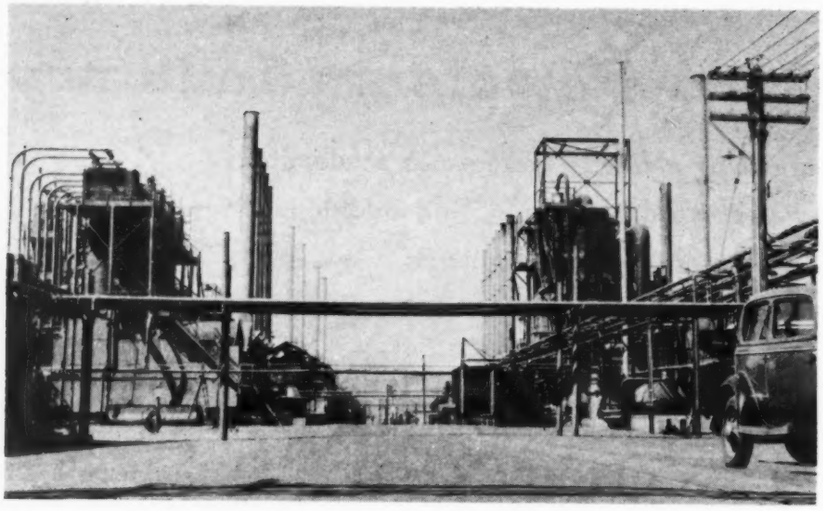
Progress is marked by a steady increase in production, accelerated by exploratory activity, and additions to pipe-line and refining facilities

Bolivia remains an unimportant factor at the present time, its production now being slightly more than 100,000 bbl. per year.

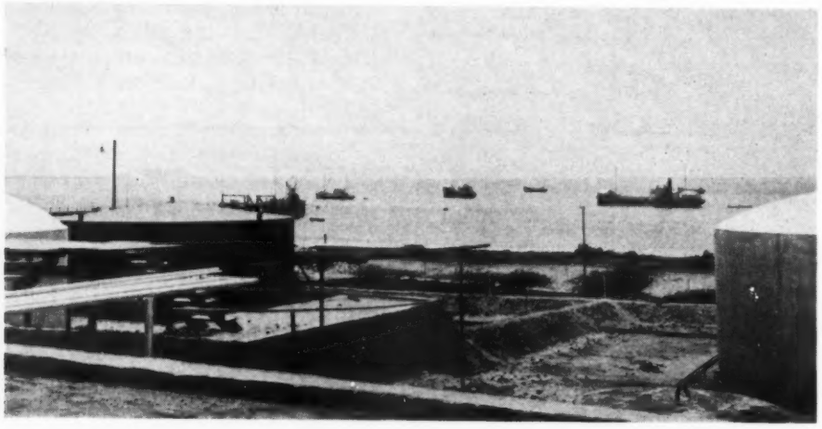
Little can yet be said concerning the future of Brazil because so little time has elapsed since nationalization of the industry and it is difficult to predict what may happen. Brazil is an immense country, and important petroleum reservoirs may be discovered in more than one area. The upper Amazon basin extends to the border of Peru near which oil was recently discovered. Other areas, in which some tests already have been made, may prove even more valuable. Several tests will shortly be drilled by rotary along the coast between Pernambuco and Bahia. Greater geophysical prospecting will probably be necessary in many areas, however, and considerably more exploratory drilling will have to be done before any commercially-productive fields can be expected.

Somewhat extensive geological and geophysical work will be carried on in Guiana. Several years ago some exploratory work was done in British Guiana but only one well was reported as having been drilled. Rights to explore in this territory have now been given exclusively to British interests, which have at least one party in operation at the present time. Exploratory rights in Dutch Guiana have similarly been assigned to interests in the Netherlands. No indication of prospecting in French Guiana has been reported.

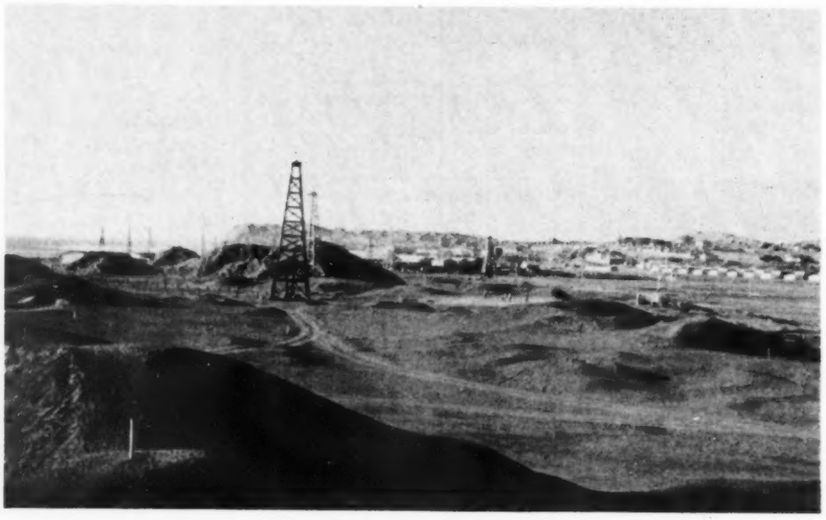




Stills and cracking units, Talara refinery



Anglo-Ecuadorian port at La Libertad



View of Negritos field, Peru

Considering South America as a whole, the future prospects for oil cannot yet be truly evaluated. In many sections geological work has been conducted under great difficulties. Geophysical methods have already facilitated structure location but even when possible structures are mapped it is frequently almost impossible from an economic standpoint to drill a well. Transportation of equipment, operating difficulties, and other hazards may make the venture inexpedient. Then, after oil is discovered, comes the problem of transporting it to a point where it may be available for use. That great difficulties have been overcome is evident from fields already producing and delivering crude oil to pipe lines such as those in Colombia carrying the oil through mountainous and inundated country. The possibilities of utilizing the Amazon system as a waterway is already presaged by the operations in eastern Peru. Fields having greater production than those now being developed may be found. In the meantime, exploration and development work is progressing and South America shows promise of maintaining its position in the world's petroleum picture.

Refining

Of particular importance in a consideration of South America's oil industry is the increase in refining capacity in Venezuela. The present laws of Venezuela require companies acquiring new acreage for exploitation of oil to construct within a limited time a refinery of not less than 10,000 bbl. daily capacity. To conform with this requirement the Shell interests have recently enlarged their refinery at San Lorenzo and the Standard Oil Company subsidiary is now completing a new refinery at Caripito. This latter supplements the topping plant, which is still in operation. The Gulf interests will soon build a refinery at Puerto La Cruz, the deep-water terminal of their new pipe line from the Oficina field.

In Trinidad the two larger refineries have been enlarged and additional expansion work will be done on both. Better refining facilities are included in the Brazilian programs and Argentina will continue to modernize and increase the refining equipment at various plants throughout that country. Further details on refineries of South America will be found in subsequent articles.

Maps

The locations of producing oil fields, active test areas, refineries, and pipe lines are shown on the maps of the important oil countries of South America that appear on following pages.

New Discoveries Stimulate Interest in Ecuador

Ancon area on Santa Elena Peninsula is center of most active development

By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

ALL oil being produced in Ecuador comes from the Santa Elena Peninsula, which extends into the Pacific Ocean directly west of Guayaquil. Moreover, nearly 95 percent of the present total production is taken from one field, Ancon, which is operated by Anglo-Ecuadorian Oilfields, Ltd. Recently, however, two 150-bbl. wells were completed in the deeper zone north of the eastern end of the Ancon field, which indicates that there may be important production available between Ancon and the town of Santa Elena. The general location of the various present producing areas, some of which are almost negligible, is shown in Fig. 1.

The new wells were drilled on the Tigre Claim but are known as "Cautivo" wells, as they were drilled by Ecuador Oilfields, Ltd., a subsidiary of British Controlled Oilfields, Ltd., which developed the Cautivo field east of La Libertad. Both wells were completed at a depth of approximately 3800 ft. in a sand that appears to correlate with the deep zone in the Ancon field. (See "Ancon Field" below.) There also appears, however, to be a saddle or fault or some other uncomformity between the area discovered by the Tigre wells and the northwest productive area of the Ancon field as wells drilled on a line between the two areas were dry, indicating an unproductive area. No definite reports have been made on the nature of the discontinuance of the productive horizon that may have resulted from one of several subsurface conditions.

El Tambo Field

Northwest of the new Tigre wells is the old El Tambo field in which several wells have been drilled by the International Petroleum Company. All of these are shallow wells except one that was drilled to a depth of approximately 4000 ft. and had an initial production of about 50 bbl. per day. Between El Tambo and the new Tigre wells is a dry hole, drilled a number of years ago to the deeper sand. El Tambo production, since its discovery about eight years ago, has been only 7500 bbl.[1] to the end of 1938 but production in 1938 was 1577 bbl. compared to 778 bbl. in 1937. Of the 6 wells completed to the end of 1938, three were drilled in 1938.

The average depth of wells at El Tambo is approximately 1200 ft., completed in a sand that is probably a continuation of the Socorro sand, from which the shallow production is obtained in the Ancon field. The oil has a naphthalene base and a gravity of 34 deg. A.P.I. All wells are put on the pump as soon as completed. Whether or not there is possibility for greater production in the deeper zone is a question inasmuch as the one deep well in this field may or may not be a conclusive test. Whether the sand picked up in this well corresponds to the deep zone in the Ancon field cannot be ascertained from the available reports.

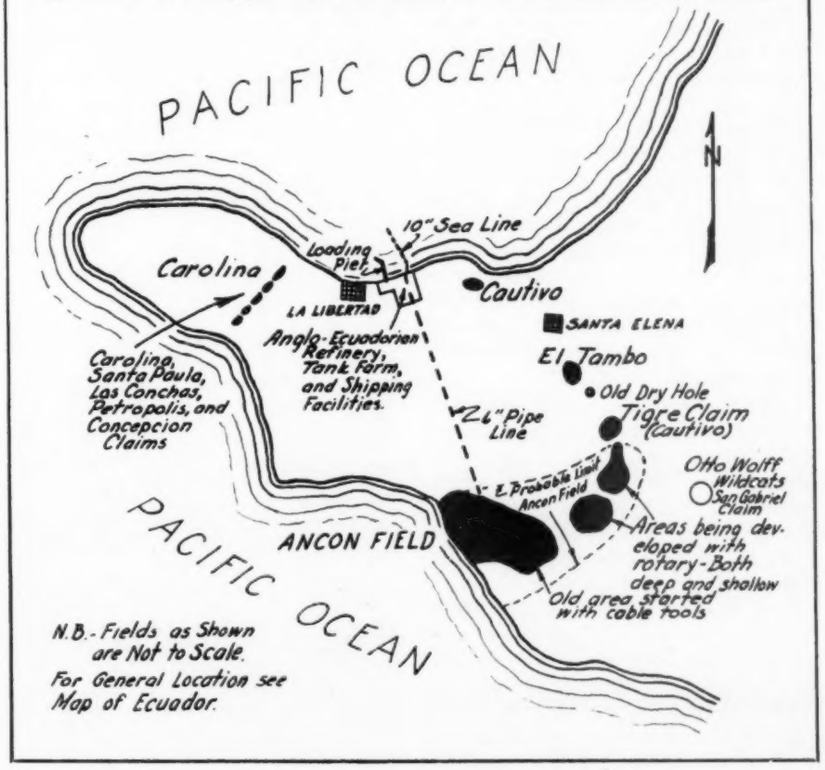
Cautivo Field

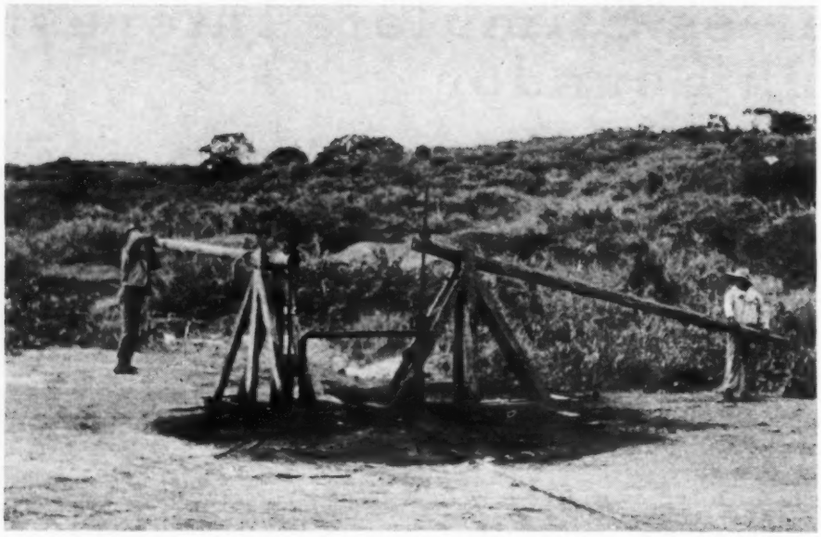
The Cautivo field northwest of Santa Elena and east of La Libertad is one of the older fields, production being from hand-dug pits and shallow wells. Total production from the field to the end of 1938 was 432,000 bbl. of which nearly 40 percent was from pits. Production in 1938 was 51,578 bbl. as compared to only 28,071 bbl. in 1937. The amount from pits in 1938, however, was only a little more than 3 percent.

How many of these pits were dug is not known but the number of wells completed to the end of 1938 was 151 of which 6 were drilled during the year. The total number of wells pro-

[1]Figures taken from "Petroleum and Gas in Ecuador" by E. Escobar P. *Petroleum Development and Technology, 1939*, p. 548. Published by A.I.M.E., 29 West 39th Street, New York, New York.

Fig. 1. All oil being produced in Ecuador is on the Santa Elena Peninsula





Pumping by hand two very old wells in one of the smaller fields of Ecuador

ducing at the end of the year was 81, two of which were flowing. The other wells were pumping. The oil from the pits is collected in cans and poured into wooden barrels that are rolled to small storage tanks.

The crude from the wells comes from the Socorro sand at depths to 1000 ft. and has a gravity of 30 deg. A.P.I. or more. The oil from the pits is found at from 28 to 30 ft. below the surface of the ground and is a heavier oil of less than 20 deg. A.P.I. One well is drilled in this area to nearly 4000 ft.

Carolina Field

To the west of La Libertad there are a number of small producing areas extending almost across the peninsula. This area is known as the Carolina field and most of the claims are operated by the Caroline Oil Company. Four claims of this company are producing some oil and consist of the Carolina, Santa Paula, Las Conchas, and Petropolis. Another claim, Concepcion, belongs to the Concepcion Ecuadorian Oilfields. These claims are scattered throughout the peninsula and portions of each may be several miles from the rest of the claim.

The Carolina operations consist of pits and wells similar to the Cautivo field. To the end of 1938, total production was 498,500 bbl. of which more than 70 percent came from pits. During 1938, production was 66,993 bbl., of which nearly 40 percent was from pits. There were 40 wells completed to the end of 1938 and at the end of the year 28 were pumping and 1 flowing. Only one well was drilled last year. The pits were produced as described above for Cautivo. Well depths average 600 ft. and the deepest well did not go much below 1000 ft. The character of the oil from wells and pits is about the same as from Cautivo.

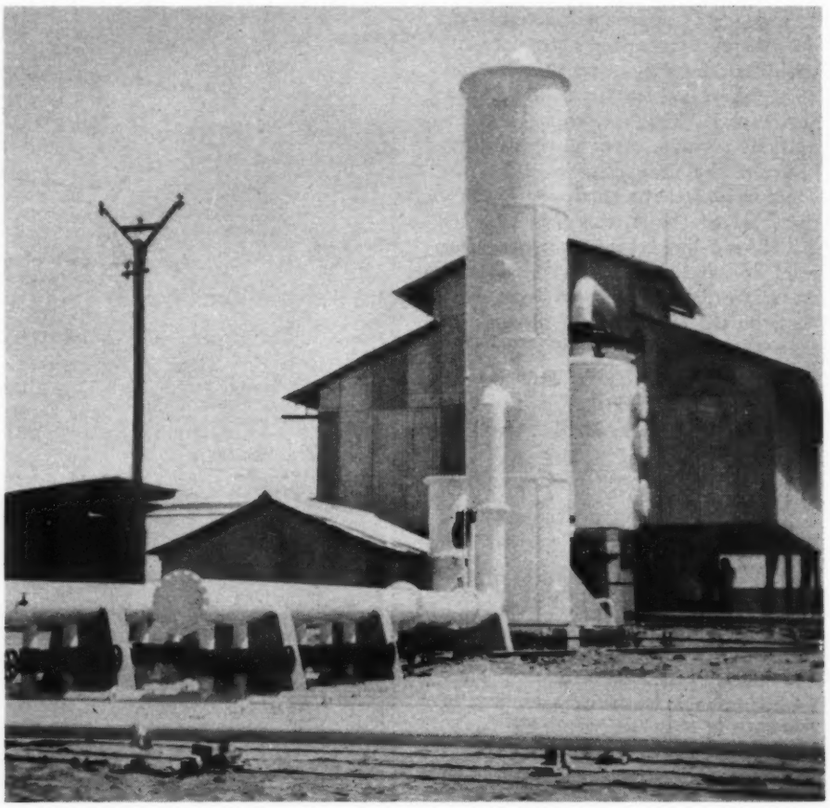
There have been only six wells completed on the Concepcion claim to the end of 1938. Production to that time had been 68,000 bbl. During 1938, production was approximately 10,000 bbl. One well was drilled during the year and only 4 wells were producing at the end of the year.

A German company operating under the name of Otto Wolff has moved in material for testing the San Gabriel claim east of the Ancon field. It is reported that two wells have been drilled on this claim but that neither has made a conclusive test.

Ancon Field

As shown in Fig. 1 the Ancon field is being developed in three areas but subsurface conditions seem to indicate that the entire area indicated by the broken line may be productive. The older area along the shore was first developed by cable tools but later wells in this as in the other two active areas shown were drilled with rotary.

Production from the Ancon field during 1938 was 2,119,500 bbl., a slight increase over the previous year. Of this production more than 80 percent was paraffin-base oil from the lower zone having an export gravity of 41 deg. A.P.I. and a high cold-test. The remainder was naphthalene-base oil from the shallow zone having an export gravity of 37 deg. A.P.I. and a low cold-test. To the end of 1938



Charcoal absorption plants of this type treat most of the gas from the deep sand wells in the Ancon field

3 OF A KIND FOR SERVICE...

WITH AN ACE IN THE HOLE!

For dependable oil-field performance you'll look far before you find the equal of the three heavy-duty "American" roller bearings pictured here.

At top is the American Radial Bearing, winning friends constantly for its efficient handling of radial loads. Beneath it is the American Full-Roller Bearing, and the design of this type of bearing was pioneered and *proved* by "American." At the bottom is the American Super-Heavy-Duty, built to withstand unusually heavy loads.

The "ace in the hole" is the extra something that distinguishes every American Bearing—the ability to *stand* up under the most severe oil-field service without fail. Our engineers invite you to consult them on any bearing problem, whatever the installation.

●

AMERICAN ROLLER BEARING COMPANY

PITTSBURGH, PENNSYLVANIA

Pacific Coast Office:
321 W. Pico Street, Los Angeles

AMERICAN *HEAVY DUTY* ROLLER BEARINGS

there had been 182 wells completed in the lower zone and 344 in the shallow sand. During 1938 there were 4 wells completed in the lower and 28 in the shallow, 2 in the former and 12 in the latter zone being abandoned. At present there are 5 rotary rigs operating, 4 for deep drilling and 1 for shallow. At the end of the year 167 wells were producing from the lower zone and 289 from the shallow sand. There were 31 wells flowing from the lower zone but all other wells were on the pump. The deep-sand wells usually flow upon completion but large producing wells are often offset by smaller ones.

The shallow-sand wells average from 1000 to 1300 ft. in depth. In drilling these wells, the rig is set on plank foundations. The shallow zone is lenticular and the oil comes from a large number of thin sands. In general, the shallow sand locations are made at the points of equilateral triangles, approximately 90 meters (295 ft.) apart. Initial production from subsequent wells drilled in the center of these triangles is apparently unaffected by the other wells no matter how long the previous wells have been producing. The shallow wells must be pumped as soon as completed and average 25 bbl. per day. There is virtually no gas produced with the oil from these wells and the decline is normal throughout the area.

The deep sand wells are generally about 4000 ft. in depth but some are deeper than 5000 ft. The structure of this zone is rather unusual; it was once thought that the sand had no porosity but it is now known to be at least somewhat porous. The oil comes from innumerable fissures in the formation, however, and the sand can be considered virtually unsaturated. Its total thickness is as great as 2000 ft. There is no uniformity in the oil-bearing characteristics of the sand over the productive area as indicated by the large wells that are offset by small producers. In spite of this spotted accumulation of oil the rate of decline is very low.

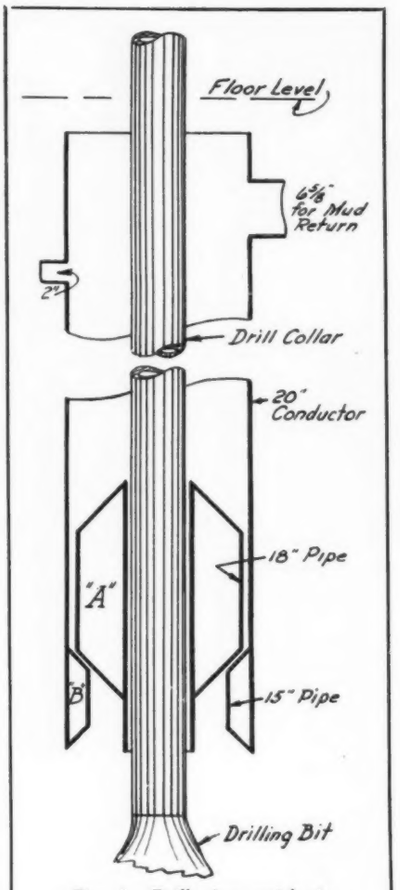


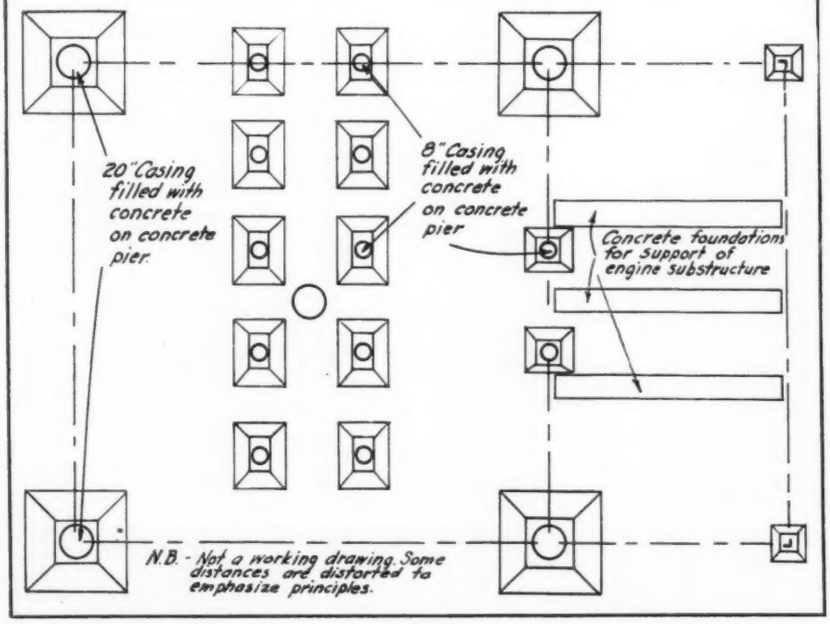
Fig. 2. Drill-pipe guide in conductor pipe

In drilling the deep-sand wells, 3-way drag bits and rock bits are used exclusively. The formations are excessively hard; in building-up the drag bits, more than 2 lb. of hard-metal inserts are used on each bit. Even when hard-metal cutting edges and reinforcements are provided, the bits wear down rapidly. No reamers are used and the hole is kept to gauge by each new bit that is used.

One method used, however, to keep the hole straight and in good condition is illustrated in Fig. 2. Before running the 20-in. conductor string in the hole, a short length of 15-in. pipe is welded to the bottom and joined to the 20-in. pipe by pieces at an angle of 45 deg. as shown at "B." Before the bit is made-up on the drill collar, a centering device, "A," is slipped over the drill collar. This device, made of a section of 18-in. pipe welded concentrically on a length of pipe of size that will allow it to slide on the drill collar and drill pipe, is designed to rest on "B" and thus keep the drill pipe centered at the bottom of the conductor string.

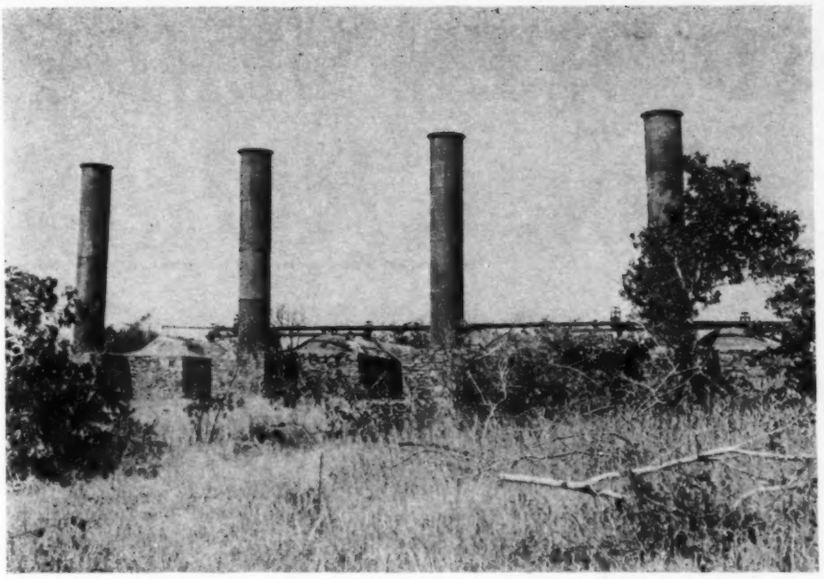
The arrangement of the derrick and rig foundation being used currently for drilling the deep-sand wells in the Ancon field is shown in Fig. 3. The steel derricks are 120 ft. in height. The derrick legs are supported on vertical lengths of 20-in. casing filled by concrete and set on concrete piers. No load except that carried by the derrick itself is put on these foundations. The table, drawworks, and other floor loads are carried by vertical lengths of 8-in. casing also filled by concrete and set on concrete piers.

Fig. 3. Foundation arrangement for rotary rigs


20" Casing filled with concrete on concrete pier
8" Casing filled with concrete on concrete pier
Concrete foundations for support of engine substructure
N.B. - Not a working drawing. Some distances are distorted to emphasize principles.

The engine is supported by a steel substructure made of any available structural pieces and these members are supported by three concrete foundations as shown in the drawing. The engine support is not connected to the derrick-floor structure in any way; there is even a space of a fraction of an inch or more separating the engine substructure from the floor members. Thus no vibration may be transferred to either unit from action or loads applied to the other. No cellar is dug at the hole but the floor level can be made any desired height aboveground by employing the proper lengths of 20-in and 8-in. pipe for support.

The ground below the derrick floor is covered by a thin concrete slab having just sufficient slope to drain water



Sea water is used for drilling in the Ancon field and this type of boiler with its masonry of native rocks is used to generate steam

or mud fluid to a ditch at one side to be carried away. This keeps the surface below the floor in good, safe working condition.

The mud pumps are mounted on skids and set on the ground nearby. Mud fluid is made from native clays and has good colloidal properties. Pressures encountered in drilling do not exceed 1100 lb. per sq. in. so the mud does not have to be heavy and is usually maintained at a weight of approximately 10.5 lb. per gal. (78.5 lb. per cu. ft.)

A matter of importance in the operation of the Ancon field is the lack of fresh water. Being on the ocean, salt water is used for steam generation, making-up drilling mud, and similar operations. Cornish-type boilers supply the steam for drilling but they have to be blown-down every hour and have to be scraped and cleaned every two or three weeks. All condensate that can be recovered economically is utilized to dilute the salt water. A considerable amount of masonry using native rock as material is required for the boiler installations; one installation is made to serve the drilling of several shallow wells.

The average gas-oil ratio from the field probably averages less than 500 cu. ft. per bbl. of oil and seldom is as much as 1000 cu. ft. even in newly-completed wells. Production passes through a separator and the gas goes to a charcoal absorption plant or a compressor station. At some of the compressor stations the wet gas is treated in an absorber constructed in the field.

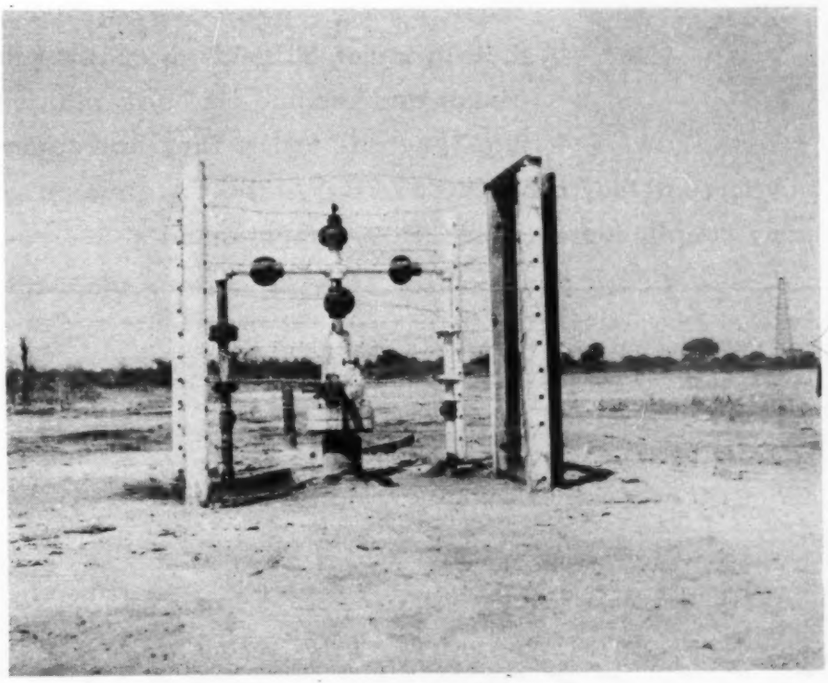
A government owned-and-operated railroad connects La Libertad, Santa Elena, and Guayaquil, but most of the company's equipment and supplies are shipped-in to the port at La Libertad. A 60-cm.-gauge railroad operated by Anglo-Ecuadorian Oilfields, Ltd., runs from the port to the Ancon field and material is hauled over this line by 40-hp. gasoline and Diesel engine-driven locomotives.

Operations at La Libertad

Crude oil from the Ancon field is piped 12 miles to a tank farm at La Libertad through a 6-in. line. This tank farm has a storage capacity of 6500 tons (45,000 bbl.). La Libertad is also the site of the Anglo-Ecuadorian refinery, pier, sea line, ice plant, and oxygen plant. Electric current for general lighting in field and plant and for refinery operations is generated at a plant situated at Ancon. Distillation units for the supply of fresh water are situated both at the refinery and at Ancon. Steam generation and other operations in which the use of fresh water is not essential, employ salt water as in the Ancon field.

The refinery processes approximately 1000 bbl. of crude oil per day and the rest of the production from the Ancon field is shipped by tanker to various parts of the world. A 10-in. sea line that extends two miles offshore is used to load crude oil into tankers. Ships taking refined products are loaded at the pier through four 4-in. lines.

The products manufactured at the refinery consist of gasoline, kerosene, heavy naphtha, gas oil, and fuel oil. The whole of Ecuador is supplied by these products through bulk stations situated throughout the country. Bulk shipments are carried by boats loaded through the four pier lines but in addition to the bulk shipments there is a considerable volume of refined products shipped in cans.



Flowing wells in the Ancon field are protected as shown here

Major operator, drilling in Peru, says . . .

"WHAT HAD BEEN NEEDED WAS SOME 16 IN. CRUMS."

For drilling "The Hardest Surface Hole His Outfit Had Ever Made!"

This excerpt is from an article by a major operator, telling about his experience in opening a new field in Peru. It appeared on page 34 of the November, 1938, issue of "World Petroleum."

Th[illegible] was worn out quickly and going was tough with only the fishtails to make hole. The reaming was hard and it was decided that on the next job there would be plenty of bits. After the pipe was set it didn't matter; the crew had good bits and the formation cuts with rock bits. What had been needed was some 16 in. Crums. Mr. ——— said that it was the hardest surface hole his outfit had ever made, with the possible exception of Jacalitos Canon—and he's had plenty of experience.

When Mr. ——— left Peru, the returns were getting warm as though approaching something hot in the ground. The vicinity is called Aqua Caliente after the hotwater springs which occur around the perimeter [illegible]

When we say Crum-Brainard Rock Bits OUTPERFORM we mean just that. In major oil fields throughout the world these bits are making new friends and keeping old ones with performance records that are outstanding. They drill faster. They drill straighter. They stay in the hole longer. All the way through they are HONEST BIT VALUE. Try them on your current drilling job and see for yourself why operators are so enthusiastic about them!

Crum-Brainard Roller Bits are made in two types to meet the drilling conditions encountered in all types of formations. Type "OC," made in 6½" to 20" sizes, has short teeth and sharply tapered cutters for maximum efficiency in abrasive formations. Type "O," made in 9½" to 20" sizes, has longer teeth and less sharply tapered cutters for highest efficiency in softer formations.

Write for Bulletin describing these Bits!

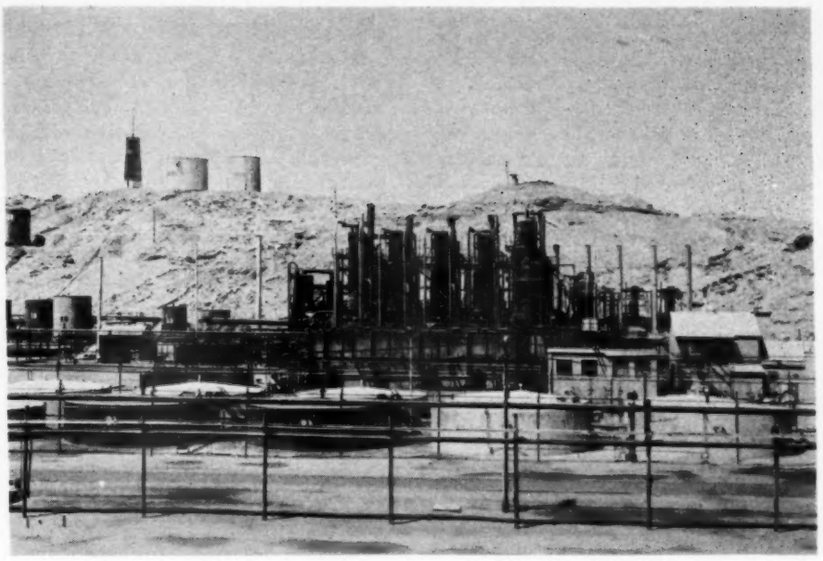
Crum Brainard

CB

217 MAGNOLIA AVENUE ★ WHITTIER, CALIFORN

BRANCH WAREHOUSES

PETROLEUM SERVICE CO., SANTA MARIA, CALIF. ★ VALLEY WAREHOUSE, BAKERSFIELD, CALIF. ★ B & G SERVICE CO., AVENAL



Cracking units at Talara refinery

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Discovery on Inland Slope of Andes Increases Scope of Peru's Activity

Negritos district, oldest and most important in Peru, still leads in production

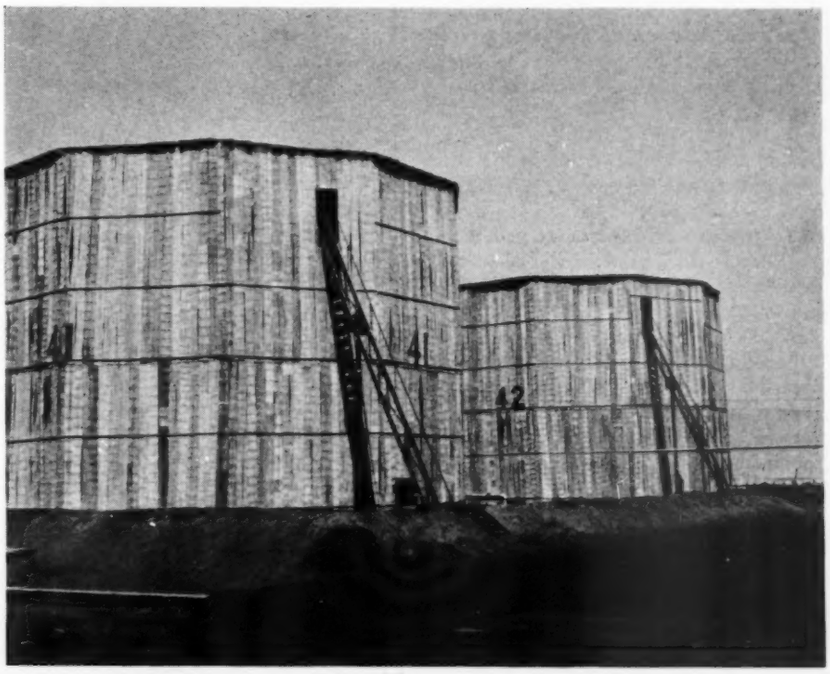
By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

ALTHOUGH virtually all of the oil being produced in Peru is still from the coastal fields in the extreme northern part of the country, the discovery of oil in February of this year by "Blue Goose" (Compania de Petroleo Ganzo Azul) on the eastern slope of the Andes has called attention not only to possible production in other areas but also to the problems of transportation that will accompany operations in fields situated beyond the mountains from the sea coast. That further exploratory work can be expected in the less accessible areas is evidenced, however, by a renewal of leasing activity around Contamana north of the "Blue Goose" operations and by continued geological prospecting by the Government in the Pirin region near Lake Titicaca in southern Peru.

Total production from Peru, the first country in South America to produce oil commercially, was 15,838,610 bbl. in 1938, which brought the total to the end of the year to 238,689,522 bbl.[1]

[1]Figures taken from "Petroleum Development in Peru During 1938" by Oliver B. Hopkins, *Petroleum Development and Technology, 1939*, p.576. Published by A.I.M.E., 29 West 39th St., New York, New York.

Of last year's production, 83 percen was produced by the La Brea y Parinas Estate, which is indicated on the map (Fig. 1), as the Negritos District. The remaining 17 percent, ex-



Tanks covered with Guayaquil cane are used for gasoline storage at Talara

cept approximately 40,000 bbl. taken from the Zorritos field to the north, was produced in the Lobitos District.

The Negritos District

The La Brea y Parinas Estate, which for convenience is here designated the Negritos District, is operated by the International Petroleum Company, Ltd. Headquarters for field operations are at Negritos, where the company has its main production offices and camp. Field offices, camps, gasoline plants, compressor stations, pump stations, and other necessary facilities are situated at the various producing areas.

The oil is produced in the several areas shown in Fig. 1 and is piped to Talara, the site of a large refinery and tank farm. Pipe lines are all laid aboveground as soil conditions make buried lines inadvisable. Salt corrosion is probably the worst factor. Pump stations throughout the fields are situated, where possible, so that oil from the field batteries gravitates to them. Main lines carry the oil to check-gauge tanks that stand on the escarpment just south of Talara and from these tanks the crude oil gravitates to the tank farm.

A network of narrow-gauge tracks connects the different producing areas and forms a railway system that runs from Talara to the Chira River (approximately 25 miles south of Negritos) from which the water supply for all the International's operations is obtained. This railway, and the asphalt automobile tracks making it a combined railway and automobile road, is fully described in an article elsewhere in this issue.

Although the first commercial production from Peru was reported in 1896, the area around Negritos is actually about 50 years old. The total amount of oil produced from the entire Negritos District to the end of 1938 was 191,529,000 bbl. Last year the production was 13,138,000 bbl.—slightly less than the 14,723,000 bbl. produced in 1937.

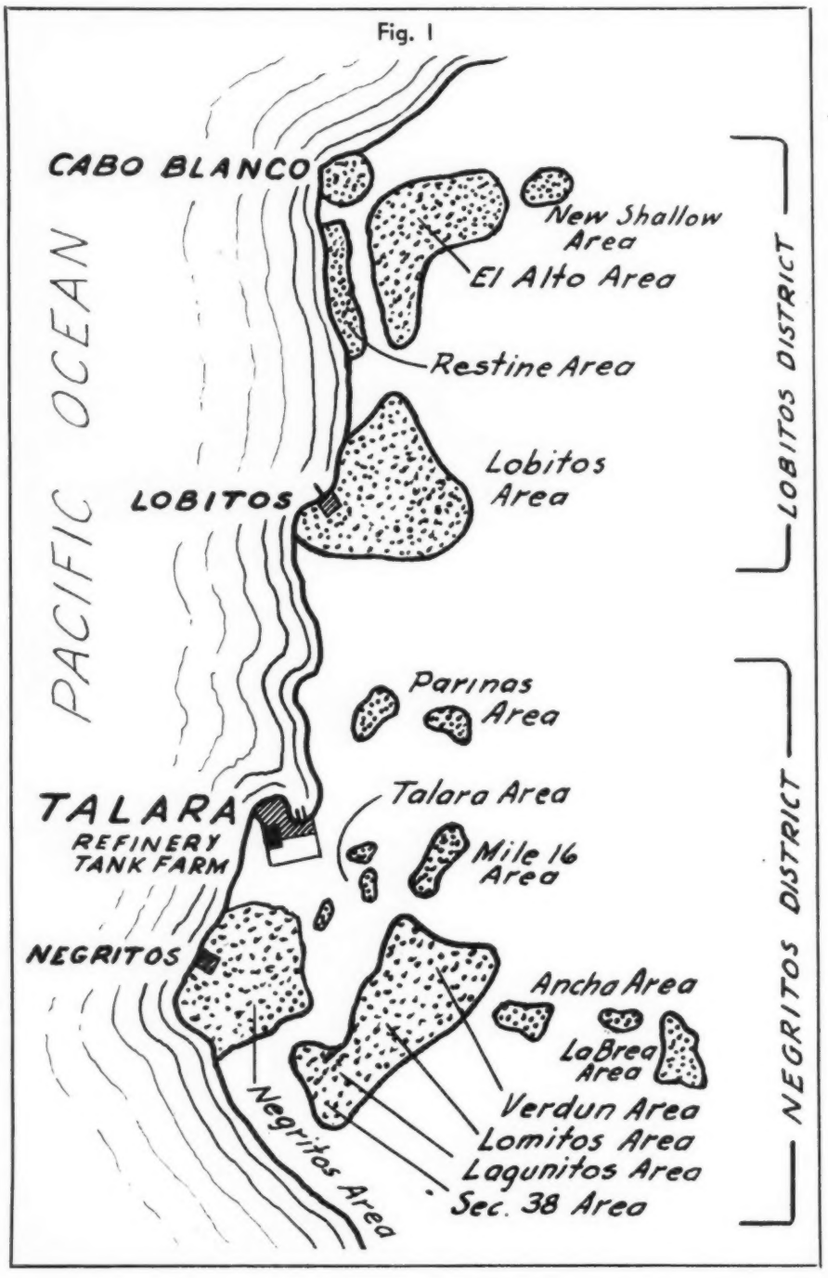
To the end of 1938 there had been 3038 wells completed in the Negritos District of which 65 were drilled during 1938. At the end of the year, there were 1842 wells producing oil and gas, 19 producing gas only, and 83 temporarily shut down. Of the total of 1944 producible wells, 92 were flowing, 9 were on gas-lift, and 34 were used for injection into the reservoir. The rest required pumping.

Several semi-wildcat wells were drilled during last year to extend the known productive areas. Deepening of older wells resulted in some increase of production. It is also reported that experimental work on water-flooding by injection into downdip wells gave promise of favorable results in at least one of three areas that have been assigned to testing this mode of operation.[1]

Production comes from four main sands of Eocene age. These sands, the Verdun, the Lomitos, the Perinas, and the Salinas are usually separated definitely but in some wells the separation between the last three is not always distinct. Both high cold-test oil and low cold-test oil are produced and are often found in the same sand. The high cold-test oil is not, however, found at a depth of less than 1000 ft. and the low cold-test is never found at a depth greater than 2000 ft. A shallow well in a certain productive sand may yield low cold-test oil and a deeper well in the same sand may produce only high cold-test oil. The gravity of the high cold-test oil averages about 40 deg. A.P.I.; that of the low cold-test is approximately 34 deg. A.P.I. The gravity seems to depend on the depth from which the oil is produced and actually runs from considerably below the average to considerably above.

The Negritos District was first developed by cable tools but at the present time both rotary and standard tools are being used. All sands have been drilled by cable tools in some areas but rotary rigs have been used for wells completed in the Parinas and Salinas sands. A considerable number of the very shallow wells having depths to 1000 ft. are drilled by portable cable-tool machines. During 1938 there were

Fig. 1

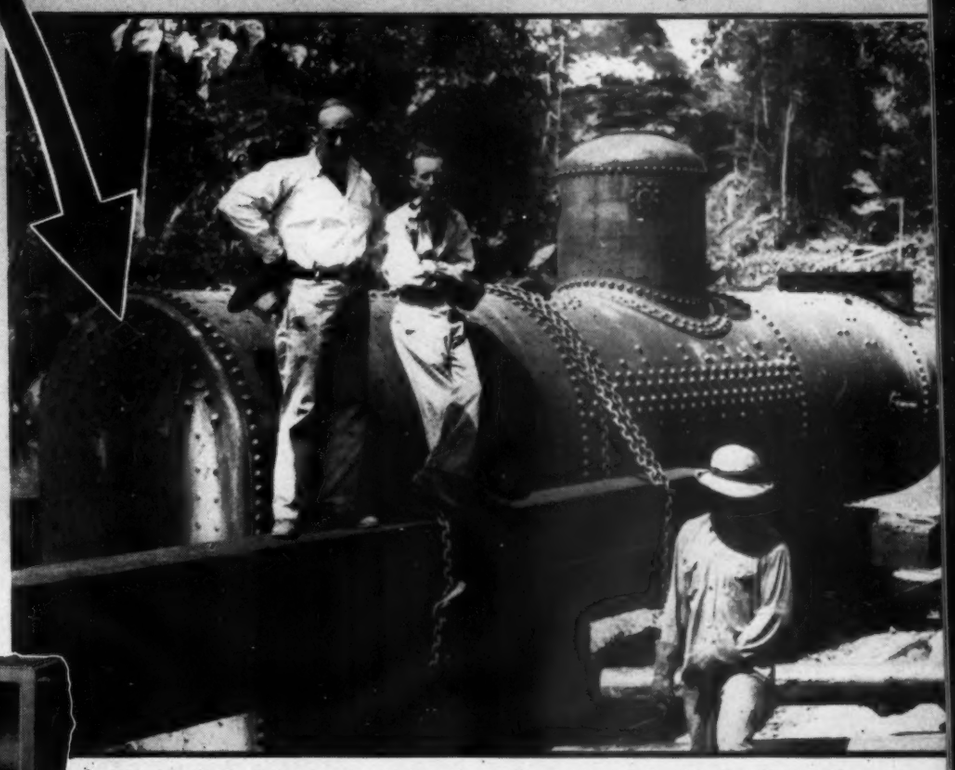


LUCEY *Efficiency and Portability*

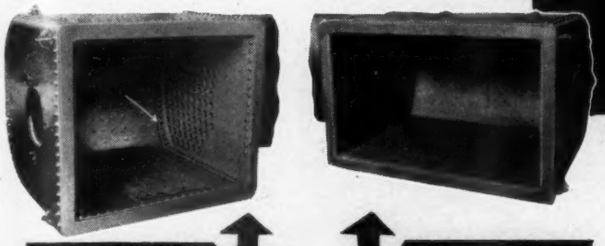
an ASSET in SOUTH AMERICA

Climate and Geography present no barriers for Lucey Boilers. Their Efficiency, Light Weight, and Easy Portability attest their Unique Design and Master Workmanship which qualify them for Oil Country Use anywhere in the world.

The All Welded Fire Box, introduced by Lucey, has increased rapidly in use and popularity. Under scientific tests their A.P.I. Rating of 104 H.P. has maintained a 132 H.P. Rating without increasing the firing rate; cutting drilling costs, reducing drilling time,-through consistent, uninterrupted performance.



Lucey Boiler being transported to Barco Concession, Colombia, South America.



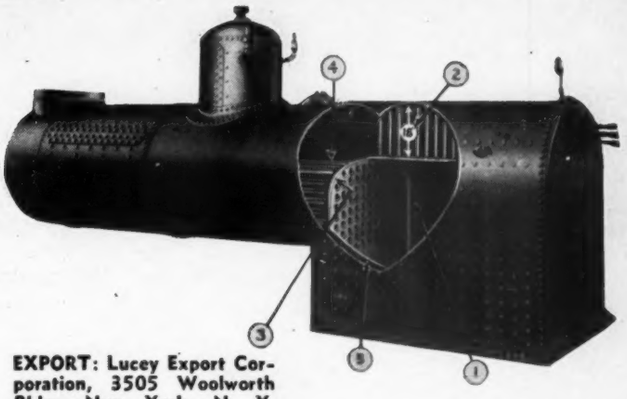
The Old Way Note Rivets and Seams.

LUCEY STYLE Welded Fire Box.

LUCEY BOILER FEATURES:

1. All-Welded Fire Box, No Rivets to Overheat or Burn. No Leaky Seams.
2. 18" Between Crown Sheet and Outside Wrapper (never less). Plenty of Steam Space with two gauges of water.
3. Arched Crown Sheet, Large Corner Radii. Good Staybolt Threads. Stronger Construction, Easy Cleaning, Better Combustion.
4. Short Tubes (13 ft.) in Vertical Rows. Effective Heating Surface.
5. 4" Water Space all around the Fire Box. Good Water Circulation.
6. Rating—A.P.I.—104 H.P.—Actual Field Test—132 H.P.
7. Weld between rows of Staybolts as specified by the A.S.M.E. Boiler Code and placed far enough away from the corners to insure the benefit of the cushion effect of the corner flanges.

WRITE FOR BULLETIN
No. 141-1 on Boilers



EXPORT: Lucey Export Corporation, 3505 Woolworth Bldg., New York, N. Y. Broad Street House, E. C. 2, London, England.

DISTRIBUTORS

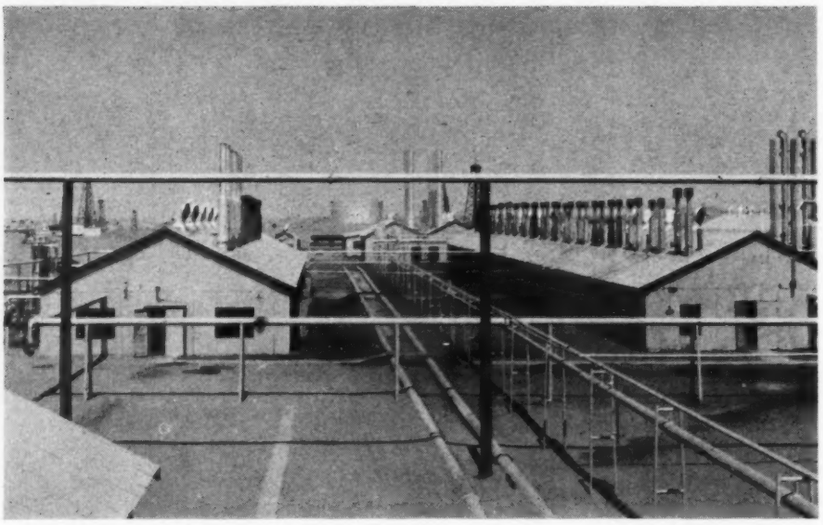
Lucey Products Corporation, Tulsa, Okla.
Bridgeport Machine Co., Wichita, Kans.
Houston Oil Field Material Co., Inc., Houston, Tex.
Murray-Brooks Hardware Co., Ltd., Lake Charles, La.
Louisiana Supply Co., Sulphur, La.

LUCEY BOILER *and* MANUFACTURING CORPORATION

539 PETROLEUM SECURITIES BLDG.
LOS ANGELES, CALIFORNIA

Chattanooga, Tenn.

811 STERLING BLDG.
HOUSTON, TEXAS



Compressor houses, Lomitos gasoline plant, Negritos district

34 wells drilled by rotary, 11 by standard tools, and 20 by cable-tool machines.

The wells range in depth from a few hundred feet to 4750 ft., the depth of the present deepest producing well. The average depth, however, is approximately 2000 ft. The average depth for new wells seems to be increasing; the average for 1937 being 2367 ft. and for 1938 being 2476 ft.[1]

Rotary rigs are used not only for the deeper wells but also for developing the lower sands in areas having high pressures, no matter what the depth. The surface string in both rotary and cable-tool wells is landed at from 200 to 300 ft. and cemented from bottom to top. In rotary wells the oil string is cemented on top of the sand, which varies in depth from 2000 ft. to more than 4000 ft. In cable-tool wells, however it is difficult to determine the casing program in advance so a protection string is usually carried to guard against caving until the productive sand is reached. When gas pressure is anticipated, mud is used in the hole. The protection string is pulled-out and an oil string run-in and cemented after the oil sand has been tapped. Liner and tubing are run in all wells for completion.

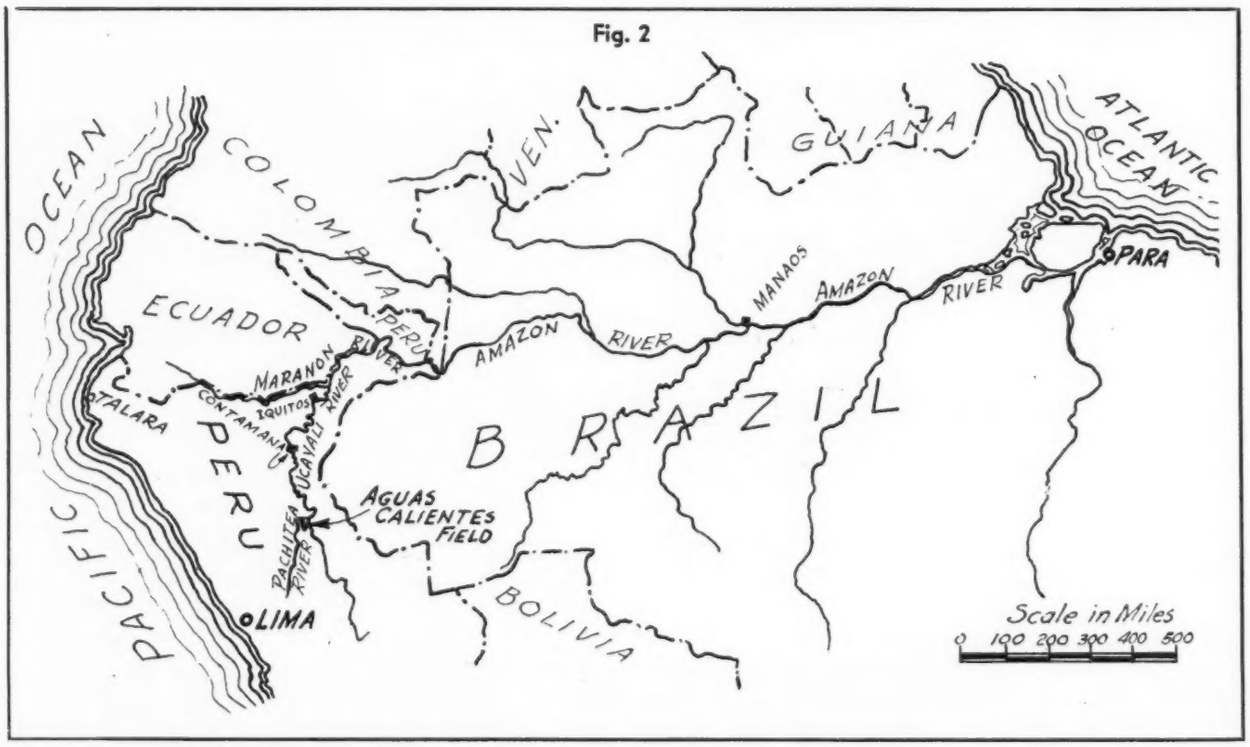
Many of the wells that first produce by natural flow are produced by gas-lift before being put on the pump. As the volume decreases, they are pumped by individual pumping units. Later, when the volume decreases further they are pumped from central stations or "catilinas."

A great number of the present pumping wells are pumped from catilinas. Jerk lines from wells to catilina are carefully designed; sags are computed to reduce friction, protect equipment, and eliminate loss of stroke. Some of the wells are nearly a half-mile from the catilina. Many of the catilinas pump as many as 38 wells each. There are a number of individual pumping units in service but most of these accommodate three or four wells.

Due to the eroded conditions, surface indications are of little help in locating the limits of productive areas or in determining possible new ones. Subsurface conditions cannot always be correlated as they may be entirely different from what might be expected from the indications supplied by the data available. Geophysical methods such as the seismograph, magnetometer, and gravity meter are therefore being used to determine possible new areas and to make locations in the present productive areas.

Flowing well production is governed by gas-oil ratio, bottom-hole pressure, and individual well conditions. The gas-oil ratio of flowing wells has av-

Fig. 2



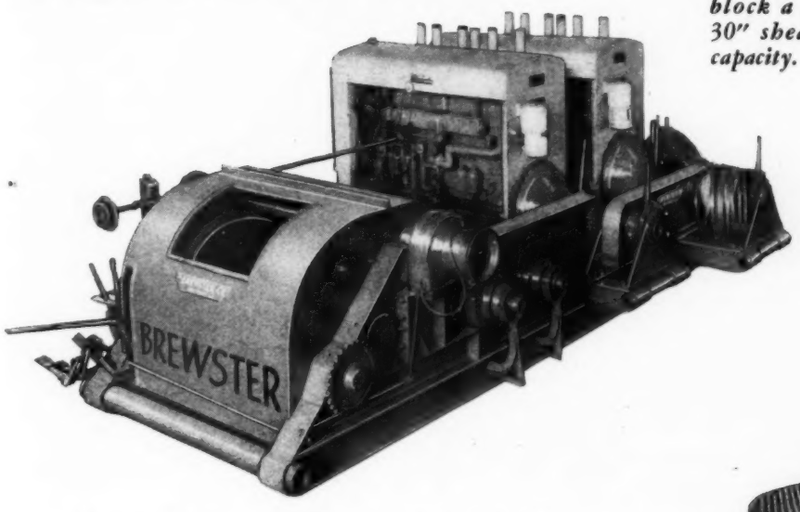
For Economical Drilling in Foreign or Domestic Fields!

BREWSTER

Modern - Portable

DRILLING EQUIPMENT

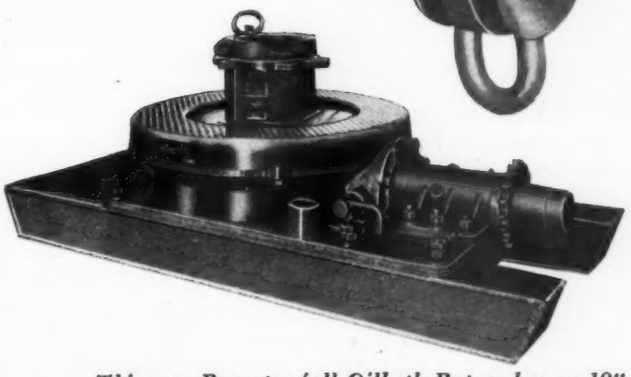
The roller bearing Crown and Traveling Blocks shown here will be a line and power saver on any portable rig. Perfectly balanced to give the traveling block a straight fall. 30" sheaves. 125 ton capacity.



The twin-motored Portable Rig shown here is known as the Brewster Model VO-190 and is capable of drilling to 6000 feet. In the complete line of Brewster Portable Rigs you will find suitable equipment to drill shallow water wells or deep-test high-pressure oil wells to 15,000 feet.

An oilbath transmission of Brewster design allows Brewster rigs to be made much more compact than other rigs of the same capacity.

WRITE, WIRE or PHONE for complete specifications and prices on the Brewster portable drilling equipment shown here. Or, let us know the equipment you're interested in and the drilling requirements and we will be glad to send quotations and complete specifications.



This new Brewster full Oilbath Rotary has an 18" table opening. Ball bearings of table and pinion gear individually oilbath lubricated. Gears machine cut and heat treated. Totally enclosed, dirt and mud proof.

THE BREWSTER COMPANY, INC.

Manufacturers of Fine Oil Field Equipment for More Than 30 Years

PHONE 2-3181 **SHREVEPORT, LA.**

NEW IBERIA - HOUMA - LAKE CHARLES - RODESSA - BUNKIE

Export Office: **Acme Well & Supply Co., 136 Liberty St., New York City**

eraged 350 cu. ft. per bbl. of oil for several years and the average for the area is less than 1000. Bottom-hole pressures are as high as 2700 lb. per sq. in. and back-pressure is held on flowing wells to an amount that will provide efficient production and high ultimate yield.

Block faulting is found throughout the Negritos District and separates the different pools in the productive areas as well as the different areas themselves. This materially helps the maintenance of pressure in the repressuring operations in the areas where this practice is being followed. No gas in the entire district is wasted, being taken from the gathering stations where it is separated from the oil by low-pressure separators and then piped to a gas plant where it is stripped by absorption. The residue from the absorption plants is used for fuel and for repressuring.

Virtually all the areas except a few of the old ones have been repressured and approximately 60 percent of the total gas production from the Negritos District is being returned to the productive sand through input wells that are more or less permanent. Although each producing area is operated as a unit, the general repressuring operation of the entire district is centrally controlled so that maximum efficiency can be obtained. The advantages of unit operation both of a producing pool and of an entire producing district are clearly evident. The results obtained have shown that they have been fully utilized.

A very effective way of treating wet gas is being followed throughout the district. At the compressor stations in the field there are absorbers to which mineral seal oil is pumped from one of three main absorption plants. After stripping the gas at the field absorbers, the rich oil is pumped back to the main natural gasoline plant that supplied the lean oil and is there passed through a distillation unit together with rich oil from the absorber situated at the plant. All stabilizing is done at only one of these plants, however, which is at Lomitos, and to which the crude gasoline from the other two absorption plants is piped. Absorption therefore is done at stations and plants near the source, distillation is consolidated at three plants, and stabilization is centralized in the one plant from which all the finished product is pumped to the refinery at Talara.

Operations at Talara

Favored with an excellent harbor, Talara provides an ideal location for the International Petroleum Company's refinery, tank farm, and shipping operations. The largest vessels can be accommodated in this port; two moles are provided for the handling of refined products, equipment for the conduct of operations, and supplies for all purposes. Crude oil is loaded into tankers through a 12-in. sea line that extends 6000 ft. from shore.

Crude exports go to all parts of the world but principally to Canada, Europe, and Argentina. Refined products supply most of the needs of Peru through the company's own marketing division. Bulk shipments of refined products go to Europe and some parts of South and Central America; case and can shipments are sent to the western coast of South America and to Central America. Cans and cases are manufactured by the company as are also lightweight drums.

The high cold-test and low cold-test oils are kept separate and although both are refined at Talara, the greater portion run is high cold-test. All lube oils, however, are made from low cold-test oil and are processed under the vacuum flash-coil system. The refinery has a throughput of more than 16,000 bbl. per day and manufactures gasoline, kerosene, fuel oil, gas oils, lube oils of all grades, and asphalt. Natural gasoline is piped to the refinery from the Lomitos plant as mentioned and also from the Lobitos operations north of Talara. More of this product is received than can be used for blending, however, so the excess is shipped for export.

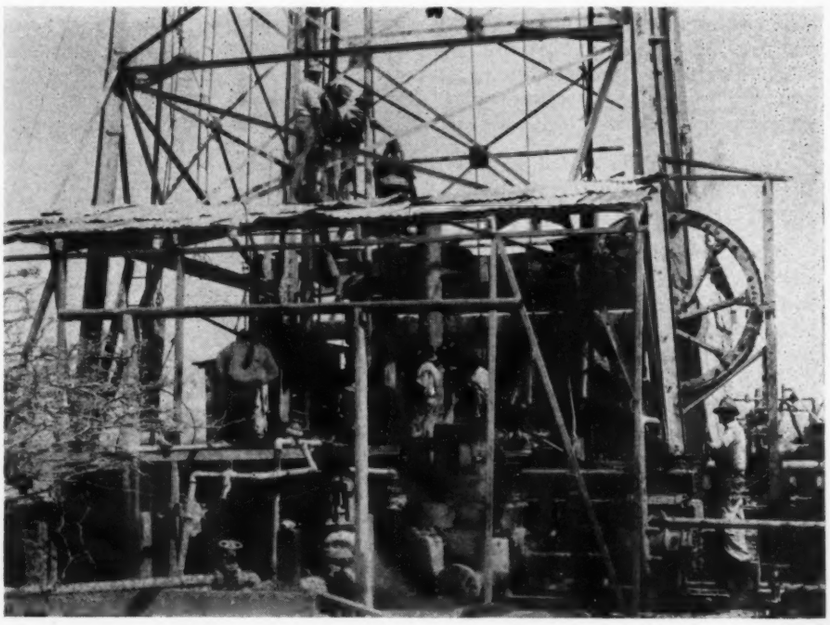
The refinery includes a cracking plant having a capacity of 7000 bbl. per day. In rectifying cracked distillate, clay tower operation is used. An absorption plant situated at the refinery strips tail gas from the various refining units. An important unit in the refinery is one for making asphalt. This asphalt is manufactured in all types (a considerable portion being in solid form either broken or pulverized) and in its various forms is widely employed in road building in Peru.

Due to the corrosive action of the soil all piping around the refinery is laid above-ground, as it is in the field. A considerable number of the lines are, in fact, placed overhead by supporting them on steel trestles.

Lobitos District

The Lobitos District, consisting of the productive areas shown in Fig. 1, is operated by Compania Petrolera Lobitos. The two main areas are, however, known as the Lobitos and Northern areas, the latter consisting of El Alto, the Coastal or Ristine area, the wells around Cabo Blanco that may be considered an extension of the Coastal area, and a new shallow area east of El Alto. As in the Negritos District, a narrow-gauge railway system connects the wells in the various productive areas to facilitate transportation of equipment and supplies. Between Lobitos and El Alto, which are the operating headquarters for the Lobitos and Northern territories, respectively, there is a broader-gauge line that is a main railway for the district. The main shops are now at El Alto, although the port with pier for vessels is at Lobitos.

Now 35 years old, this district pro-



Drilling in Peru with a rotary rig

Link-Belt rotary chains are packed in dust proof wooden boxes for convenience in shipping and handling in the field and to keep them clean and free from dirt, grit, abrasive matter, rust and corrosion. The boxes are labeled for ready identification of chain.

"Out Here" could be almost any oil field . . . because this driller's opinion is practically general among men who know real values in drilling equipment. You can check rotary chain acceptance right down the line . . . man for man, rig for rig . . . through fields and wildcat locations everywhere, and you'll find a wide margin of preference for Link-Belt.

Link-Belt Company pioneered in the art of chain making . . . was the first chain manufacturer to make a drop forged chain . . . the first to introduce and prove a chain-type for every drilling service. Link-Belt chains are engineered and built with utmost care for the finer details of construction. They provide the user with far greater strength, durability, and safety factor than average chains.

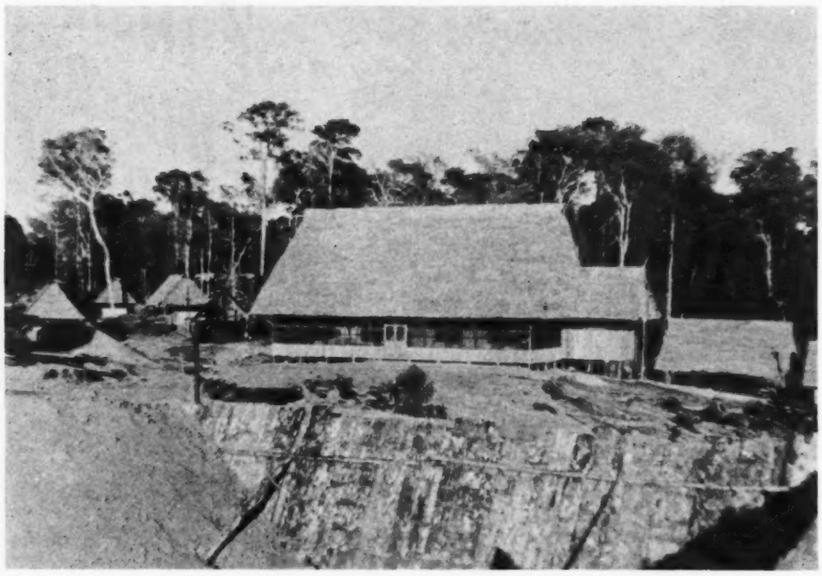
So, for faster, safer, lower cost drilling of today's deep wells, it's only natural that the oil industry looks to Link-Belt—the leading maker of fine chains for more than 65 years—for consistently smooth, trouble-free performance, regardless of depth, load, or character of service involved.

LINK-BELT COMPANY 7801

Indianapolis, Houston, Dallas, Los Angeles, Philadelphia, Chicago, New York. Distributors in all fields.

LINK-BELT CHAINS

THE CHOICE OF EXPERIENCED DRILLERS



Aguas Calientes camp of the Blue Goose Oil Company

duced a total of 43,977,000 bbl. of oil to the end of 1938. During last year the production was 2,661,000 bbl., a slight decrease from 1937, which had a production of 2,695,000 bbl. There had been 1014 wells completed to the end of the year, 32 having been drilled in 1938. The total number of wells capable of production at the end of 1938 was 741.

There are seven main producing horizons in the Lobitos District, all of Eocene age. Both high cold-test and low cold-test oil is produced—the gravity of the former averaging 37 deg. A.P.I. and of the latter 35 deg. A.P.I. Production in the Lobitos area was first from shallow wells, averaging probably less than 2000 ft. in depth. Almost all wells now drilled in this area are drilled to a depth of 4000 ft., the deep wells being completed at a depth of 4500 ft. The deepest well was drilled a depth of 6586 ft. The wells in the Northern area are all comparatively shallow; depth averages approximately 1500 ft. The sands all over the district are faulted and, as in the Negritos District, it is impossible to predict subsurface conditions.

All wells are drilled by cable tools. In the Northern area, electricity is used for all operations, the power being supplied by a plant situated in the Ristine area. In the Lobitos area, steam engines and gas engines are used for power.

Of particular interest is the fact that wells in the El Alto area have a surface elevation more than 900 ft. above those in the Ristine area along and just back from the ocean. El Alto is on a highland rising abruptly from the shore, and broken in its eastern part by deep canyons. A number of the wells in this highland area are completed at depths that are higher than the surface locations of the wells situated directly along the shore.

Some of the wells in the Lobitos District are flowing, some are on gas-lift, and some are pumping. Probably the majority of those on gas-lift are flowed intermittently. Displacement pumping has proved advantageous as one method employed to produce the wells economically. A great number of wells are pumped by catilinas; one of these central powers pumps 36 wells.

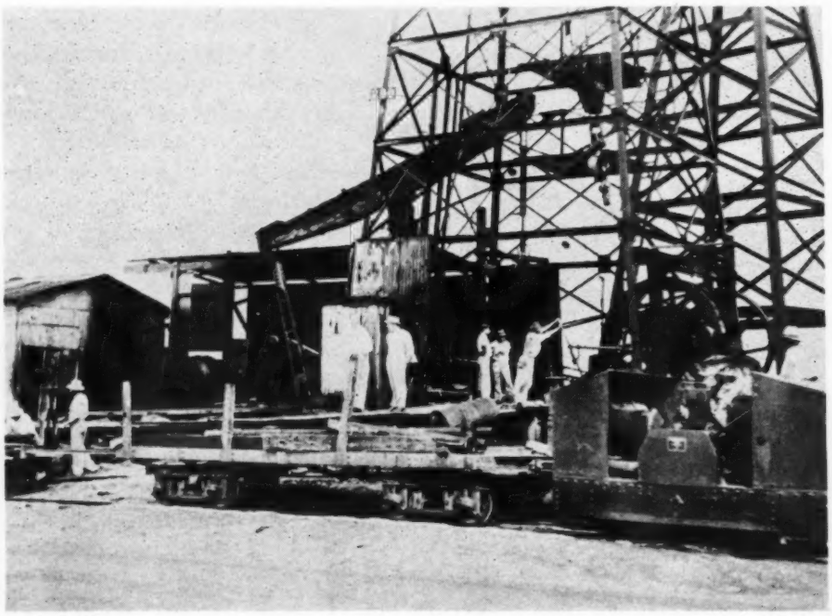
There is an absorption plant at Lobitos; compressor stations are situated in each area. Gas into the absorption plant is taken from the separators and enters the plant under a slight vacuum. Some of the residue gas is used in the Lobitos area for repressuring.

Crude oil, consigned to various destinations, is shipped from two ports. That from the Lobitos area is loaded on tankers through two 5000-ft. sea lines at Lobitos; that from the Northern area, through two 1300-ft. sea lines at Cabo Blanco. In both cases, the high cold-test and low cold-test oils are kept separate.

Zorritos Field

The Zorritos field is the oldest in South America, having been producing for about 56 years. At the present time there are 40 wells pumping a total daily production of 120 bbl. Virtually all the wells are pumped from central powers. To the end of 1938, the total oil taken from the field was 3,183,000 bbl. with approximately 40,000 bbl. being produced during the year. Operation of the field is by Sociedad Anonima Comerciale e Industrial, "Faustino G. Piaggio." The company has been planning the drilling of a few deep tests but from present reports, actual work on these has not yet started.

The Zorritos refinery is a topping plant having a rated capacity of 1000 bbl. per day but which evidently is operating at the rate of only a little more

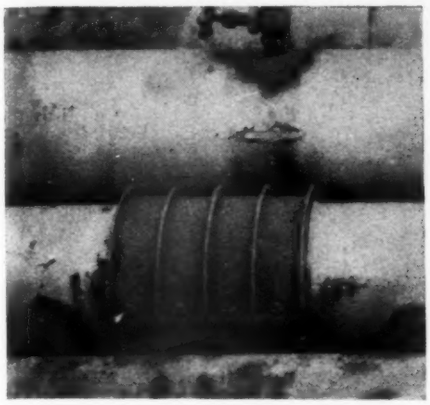


A cable-tool well at Lobitos. Note track laid to the drilling well over which equipment and material are hauled

(Photo courtesy Fred Ripley, Emsco Derrick and Equipment Company.)

SKINNER OFFERS A CLAMP FOR EVERY LEAK

Actual photographs show various useful Skinner Clamps in the field — giving safe, lasting protection. Many Skinner clamps have been in use 10 — 20 — 30 years! and more. Universally used in Oil and Gas Industry. WRITE FOR COMPLETE CATALOG!

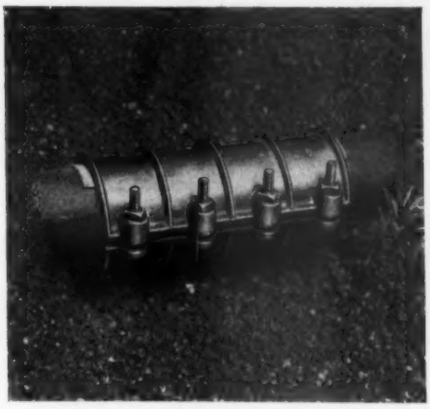


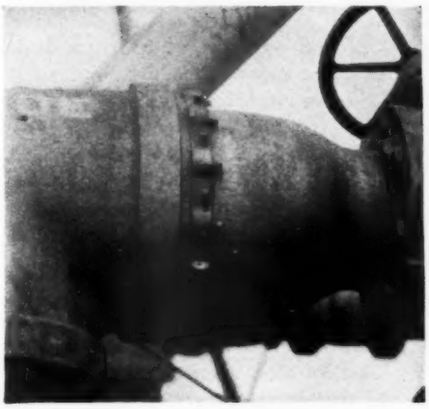
● **EMERGENCY PIPE CLAMP**

FOR stopping leaks in pipe lines, instantly, permanently. Quickly, easily applied. Pipe sizes ½" to 12". Standard in the petroleum industry for nearly forty years.

PIPE LINE CLAMP ●

FOR repairing long splits or very bad corrosion in pipe lines. Tremendously strong—suitable for highest pressures.



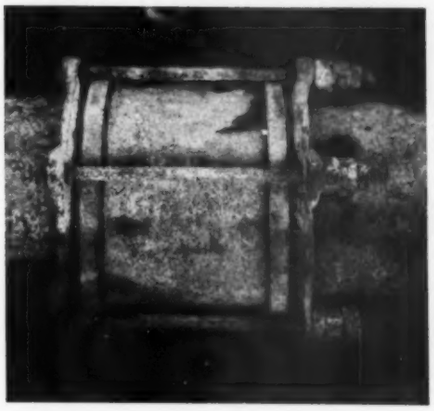


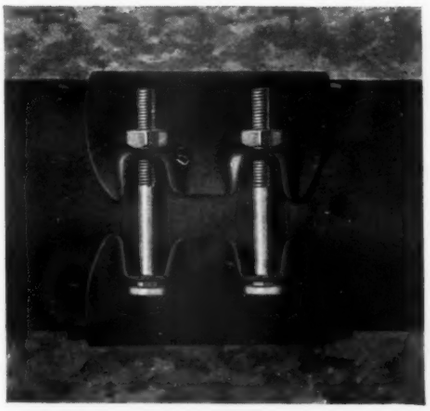
● **PIPE JOINT CLAMP**

FOR stopping leaks at joints where pipe is screwed into a fitting—any thread leak at tee, elbow, flange, gate coupling, or master gate. Without shutdown. Absolutely permanent.

COLLAR LEAK CLAMP ●

FOR stopping every type of collar leak, regardless of kind of collar used, or condition of line. Rough, tapered, or uneven collars easily clamped.



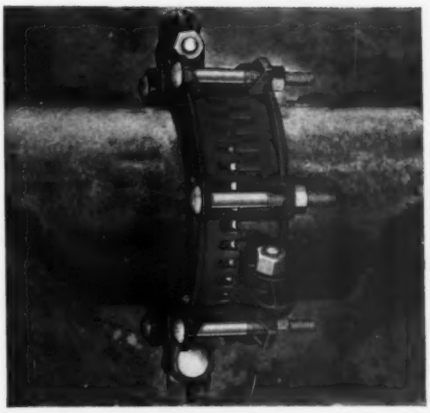


● **PRESSED STEEL ECONOMY CLAMP**

FOR repairing badly pitted and corroded pipe lines, at a minimum of cost. A strong clamp—sold in quantities for less than the cost of homemade repairs.

HIGH PRESSURE WELD CLAMP ●

FOR stopping pin hole leaks or splits in welds on welded steel pipe lines. A big time-saver. Tested to 800 lbs. line pressure.



M. B. SKINNER CO. *Est. 1898* **SOUTH BEND, IND.**

than 100 bbl. because of the actual production available. At the refinery there is storage capacity for 3000 bbl. of refined products and for 50,000 bbl. of crude oil. The refinery operations are conducted by Establecimiento Industrial de Petroleo de Zorritos, a subsidiary of the above-mentioned operating company. The company's loading pier extends 1000 ft. into the ocean and is equipped with a floating pipe line for bunkering ships and loading tankers.

Aguas Calientes Field

The discovery of the Aguas Calientes field east of the Andes and along the headwaters of the Amazon River has, of course, called attention to the vast area lying in eastern Peru and western Brazil that may or may not be the scene of further active exploratory work in the near future. Although near the Pacific Coast, outlet for oil and transportation of large equipment must be across the continent by way of the Amazon system to the Atlantic Ocean, as shown in Fig. 2.

The Aguas Calientes field is operated by the Compania de Petroleo Ganzo Azul, the "Blue Goose Oil Company," with drilling being done by the Drilling and Exploration Company, Ltd., of Los Angeles. The first well was drilled to a depth of 3104 ft. and an oil sand picked-up between the depths of 1021 and 1262 ft. Leaving this hole in condition for later deepening, the rig was skidded and an oil well completed at a total depth of 1174 ft.[2] Initial production was 750 bbl. per day through a ½-in. choke or 1000 bbl. per day through a 40/64-in. choke. Production through the 7⅝-in. casing was estimated at from 12,000 to 15,000 bbl. per day. It is believed that this well will produce as much as 2500 bbl. per day through tubing. The gravity of the oil is 45 deg. A.P.I.

Drilling is done by rotary and the casing program being followed is a short string of 11¾-in. surface casing (65 ft. in the first completed well) and a 7⅝-in. water string cemented on top of the sand at approximately 1020 ft. The well is then tubed.

Two wells have been completed and a third is drilling. Although the wells are shut-in, the first well is used to supply fuel and enough oil for processing to operate a 225-gal. still in which gasoline, kerosene, and Diesel oil is made. All three of these products are used for company operations; gasoline and Diesel oil is also supplied to the government for highway work.

The selection of equipment employed in these operations was controlled to a great extent by the transportation facilities. Although the location is but two miles from the Pachitea River, a 6-mi. road had to be built through jungle and up precipitous hills from the river landing to the camp. Equipment and supplies were unloaded at the river landing after being carried by river boats more than 3000 miles up the Amazon system from Para, Brazil. (See Fig. 2.)

The Pachitea River at Aguas Calientes is a broad stream that has 9 ft. of water over its shallowest bar during the dry season. The Pachitea empties into the Ucayali River about 20 miles downstream from Aguas Calientes; and at approximately 560 miles below this point the Ucayali joins the Maranon River, generally considered to be the upper course of the Amazon.

Steam is used for power in the "Blue Goose" operations but due to the long haul from Para it was not deemed feasible to transport fuel oil even for the first well. Wood was therefore used for fuel and special masonry constructed around the boilers for its use in generating steam.

Access to the field for personnel and small pieces of urgently-needed equipment is via Lima. An automobile road goes over the mountains to San Ramon on the eastern flank of the Andes and from there to the field two planes are used, one a land plane from which transfer is made to a pontoon plane capable of landing on the river at the company's port.

Transportation of oil from the field will probably be through a pipe line laid to a port at Pucallpa on the Ucayali River situated approximately 28 miles north of the field. At this point the oil would be loaded on lighters and carried either to Iquitos in Peru or to Manaos in Brazil for transfer to deeper-draft ships. Sea-going tankers of any draft can reach Manaos and ships of 25-ft. draft can navigate the river to Iquitos in any season. The minimum depth of the water between Iquitos and Pucallpa is approximately 12 ft. The Amazon River thus affords transportation for the conduct of operations and an outlet for crude oil production along its upper reaches.

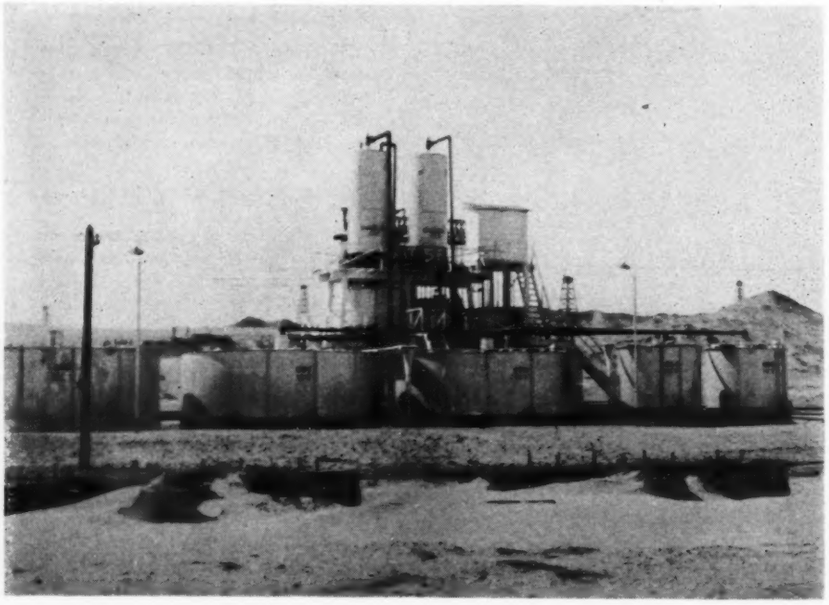
Exploratory Work in Peru

The Peruvian Government is drilling test wells at the two extremes of the country. In the north in areas south and east of the Zorritos field, numerous wells have been drilled with showings of oil picked-up in several locations. One well was located just inland from the coast near Bacapan, approximately 30 miles southeast of Zorritos.

In the south around Lake Titicaca is the Pirin Region where the government has drilled several wells and is reported to have obtained a little oil in at least one.

The discovery of the Aguas Calientes field has revived interest in the area around Contamania near which are a number of oil seeps. Leasing activity has here been renewed but no reports of actual exploration work have been received.

[2]Details on the discovery operations at Aguas Calientes are given in "Test Well In Eastern Peru Successfully Completed." *The Petroleum Engineer*, April, 1939.

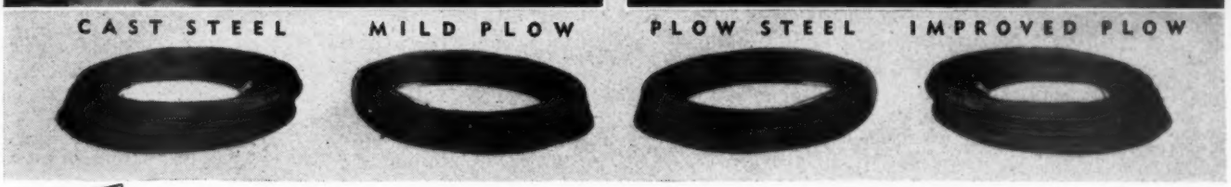


Separators and tanks at a gathering station in the Lomitos area, Negritos district

QUALITY wire rope

Weighing sample of steel for analysis, steel mill

Microscopic Inspection of rods, Union wire mill



POINT 2

QUALITY STEELS

After expert designing — the next factor in wire rope quality is the steel!

Beginning, years ago, with the accepted steel specifications for the various sizes and grades of wire, UNION rope engineers have constantly experimented in improving those specifications. Today, we have our own perfected specifications for the steel rods from which we draw each size and grade of wire.

The steel mill furnishes us an accurate, certified analysis of every heat of rods delivered. We then make our own microscopic inspection of the cross-sections of numerous samples of rods from every heat, to note "cleanness," grain size, and other physical characteristics which will determine the exact processing which should be employed in the wire mill.

Accurate control of steel quality is a basic factor in the strength, durability, and uniformity of UNION Wire Lines.

WE RECOMMEND

Union PRE-FORMED

(PRE-FORMED)

FOR

ROTARY DRILLING LINES

TUBING LINES

SUCKER ROD LINES

ALL ROPES which must endure severe bending

May we place you on our mailing list for our informative bulletin, "ROPE DOPE?"

UNION WIRE ROPE CORPORATION . . . . . KANSAS CITY, MO.

Sales Offices: Tulsa, Fort Worth, Houston, Chicago, Denver, New Orleans, Monahans

Gulf Coast Distributors: PLOWDEN SUPPLY CO., 3200 Navigation Blvd., Houston, Texas

JARECKI MFG. CO. DISTRIBUTORS: Midcontinent, Gulf Coast, New Mexico and Eastern Oil Fields

Export Agents: LUCEY EXPORT CORP., Woolworth Bldg., New York; Broad St. House, London

UNION

Brazilian Government Begins Aggressive Exploratory Program

Rotary equipment capable of drilling to 6000 ft. and deeper will be used to test structures outlined by geological and geophysical surveys

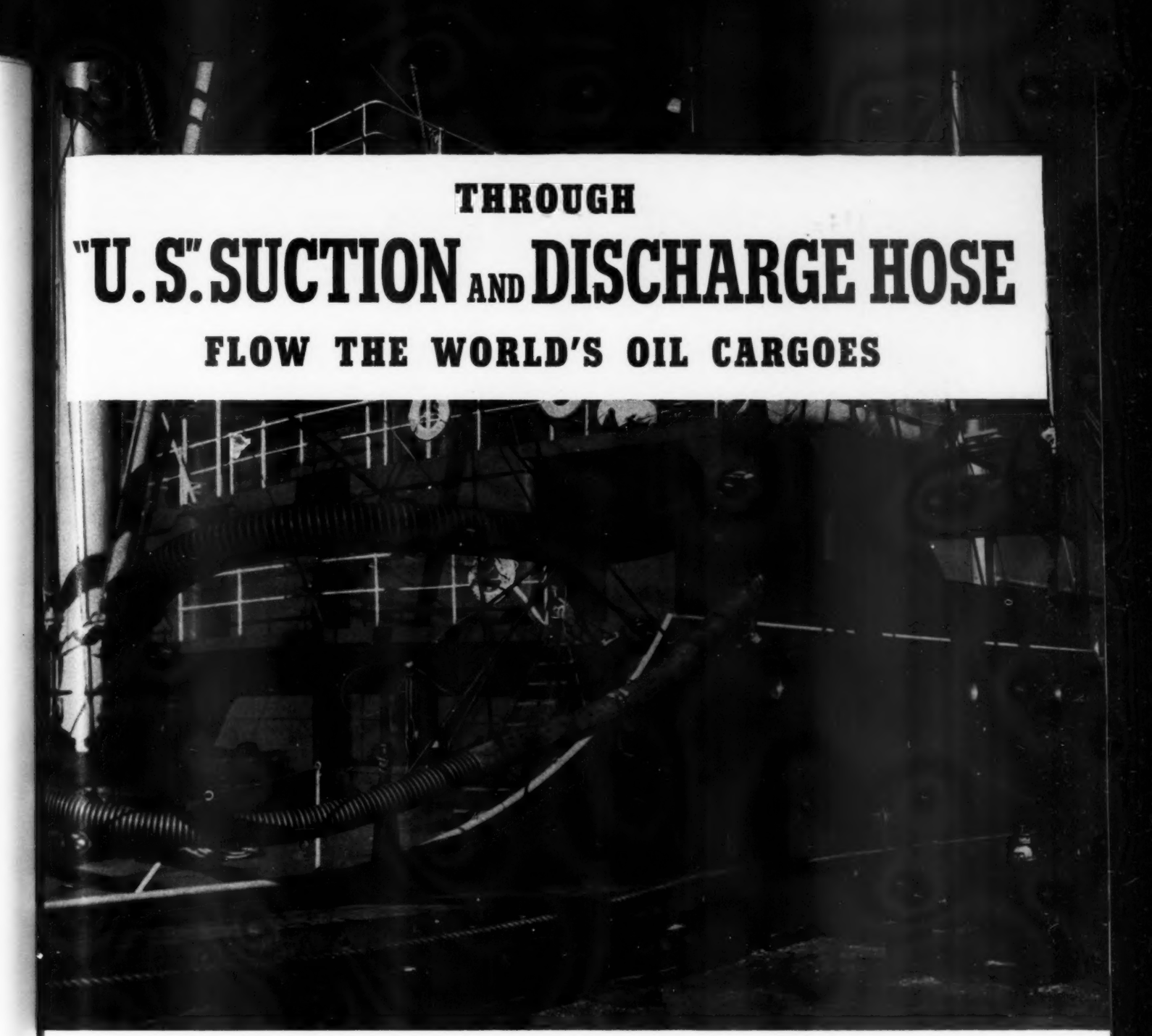
By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

THE first important step to be taken in the development of the oil resources of Brazil since the nationalization of the industry will be the immediate drilling of test wells in the coastal region in Bahia north of São Salvador. Three rotary outfits were recently purchased by the government to be used for the purpose. One very small well having production of less than one bbl. per day was recently completed by the government near São Salvador, the capital of the state of Bahia. The discovery has created considerable interest in this vicinity.

The first three wells to be drilled by the new rotary equipment will be at the locations shown on the accompanying map. One is on the island of Itaparica, across the bay from São Salvador; another is 50 km. north of the city, and the third is near the city of Maceio in the state of Alagoas. The equipment is capable of drilling to 6000 ft. or deeper. The locations were made from data provided by government geological and geophysical sur-

Map of Brazil

showing new test locations and states in which previous exploratory work has been done or is likely to to be done.



THROUGH "U. S." SUCTION AND DISCHARGE HOSE FLOW THE WORLD'S OIL CARGOES

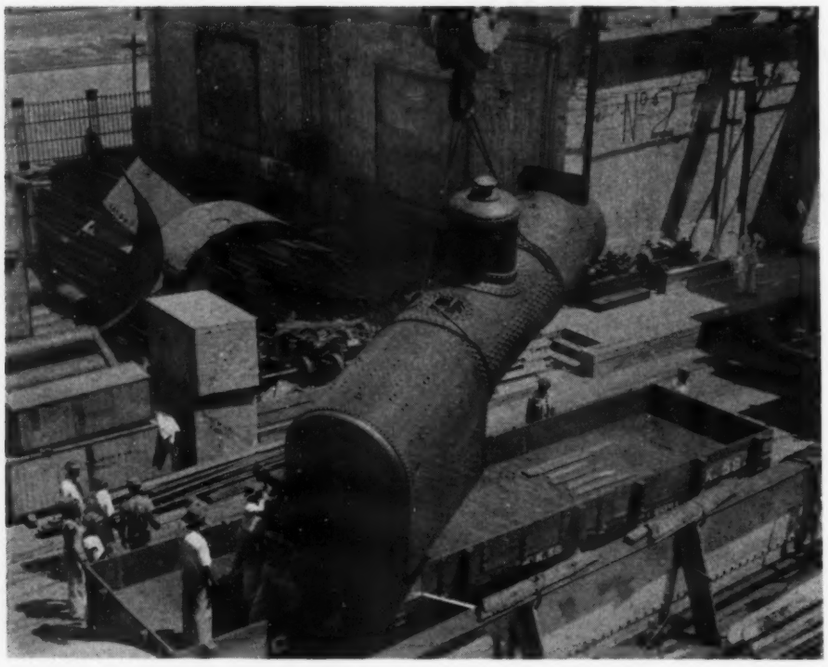
Look in at refineries and distributing terminals everywhere, on oil tankers, barges, and oil burning steamships! You'll find "U. S." Amazon Suction and Discharge Hose loading and unloading oil . . . shifting oil and gasoline from and to all corners of the earth . . . doing its job in all climates, under all conditions . . . impervious to the oil from within, or the weather and abrasion from without. "Amazon's" strong carcass and tough cover protect its rubber tube from oil contact, contribute great strength and flexibility to the hose, give SERVICE BEYOND PRICE AND SPECIFICATIONS.

"U. S." branches and representatives everywhere will be glad to give you further information and recommendations.

UNITED STATES RUBBER COMPANY · US · TRADE MARK

United States Rubber Export Co., Ltd.

1790 BROADWAY, NEW YORK, N. Y.



Loading on a flat car a boiler to be used in drilling operations in Brazil
(Photo courtesy Oil Well Supply Company)

veys conducted during the last several years.

Through an agreement between J. E. Brantly, president of Drilling and Exploration Company of Los Angeles, California, and the Conselho Nacional do Petroleo, the company will be responsible for all equipment and will direct and conduct exploratory operations. This arrangement provides for supervision by Drilling and Exploration Company of all exploratory and development work to be done by Conselho, a body established by the Brazilian government to administer and execute the development of the nation's petroleum resources. The company's organization in Brazil is headed by Edgar H. Clayton. Engineers and drillers from the United States will begin the work, Brantly advises, but technically-trained Brazilians will be schooled in rotary-drilling technique so that the entire drilling program may later be taken over by Brazilian employees.

In addition to the three immediate and other subsequent wells to be drilled in the states of Bahia and Alagoas, the government plans to explore other areas of the country. Virtually all parts of Brazil have been studied geologically and considerable geophysical work has been carried on in the states of Alagoas, Bahia, São Paulo, Parana, and Santa Catharina. Test wells have been drilled at various times during the last 40 years in these states, in Rio Grande do Sol, the most southerly state in Brazil, and in Para, south of the river in the lower Amazon basin. The greatest early activity was in São Paulo but no production of consequence was ever obtained although one well was drilled to a depth of more than 5000 ft. Most of the wells, however, were shallow, many probably not more than 1000 ft. deep.

By locating the wells around São Salvador and Maceio in territory that has been geophysically surveyed it is evident that the present information available indicates that this coastal area is most favorable. Attention should also be given, however, to Acré, a territory near the recently discovered Aguas Calientes field in Peru. Acré was obtained by Peru from Bolivia in 1903 in the settlement of a boundary dispute. This area is also close to some oil seeps in Peru, situated about 200 miles north and slightly east of the Aguas Calientes field. (See map of Peru.)

The problem of transportation, both of equipment and supplies in and of crude oil out, must be given consideration. The geographical position of the Aguas Calientes field makes it possible to bring supplies in by water to a point from which only a 6-mile road-haul is required to reach camp. Crude oil may be transported by a pipe line less than 30 miles in length to a dock at which ships of 12-ft. draft can be loaded during all of the year. Discovery of a field in the Acré district of Brazil, however, might necessitate considerable more land transportation to reach a navigable stream in the Amazon system.

The refineries of Brazil necessarily must process only imported oil at present. The largest in operation is at São Paulo and has a capacity of 1400 bbl. per day. Two others are at Rio Grande do Sol, one of which is quite small, having a capacity of from 100 to 200 bbl. per day. The refineries are, of course, subject to the nationalization laws and it is reasonable to assume that national or state governments will build plants as the necessity arises.

Drill pipe, casing, and tubing on dock at Bahia

S S C offers the accumulated experiences of more than a hundred crew years in making seismic surveys. Its field parties, operating in practically all of the major oil producing areas on this continent and abroad, have, in addition to the evaluating of millions of acres of leases, discovered more than fifty-two new producing oil fields.

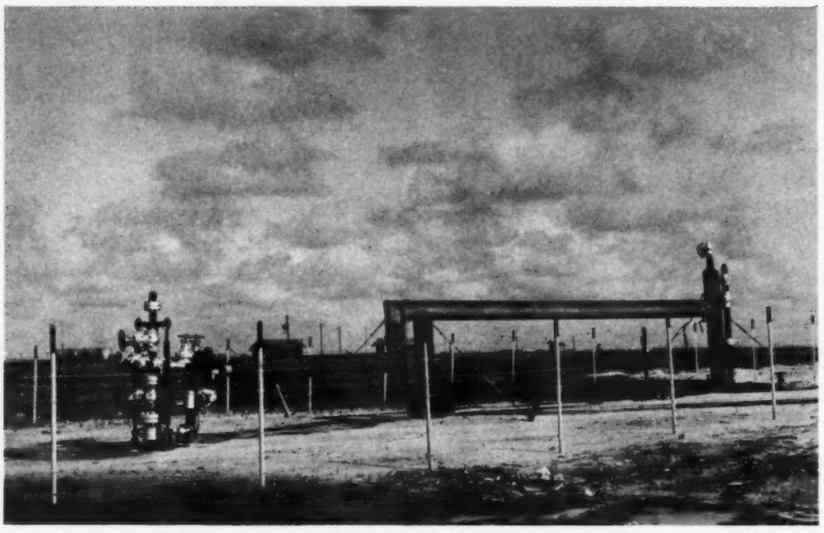
The wide experience of S S C's staff in determining the necessary technique and correctly interpreting the records, assures the proper procedure for any area to be served—this world-wide experience is at your service.

Seismograph Service Corporation

CONSULTING EXPLORATION GEOPHYSICISTS

KENNEDY BUILDING

TULSA, OKLAHOMA, U. S. A.



Wellhead connection and water knockout installation, Temblador field

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

By
WALLACE A. SAWDON
Pacific Coast and Foreign Editor

Recent Developments Have Materially Strengthened Eastern Venezuela's Position

Development of partly-proved fields adjacent to new pipe lines may increase the volume of production from area

WITH one new important field already shipping oil and another one soon to be connected to tidewater by pipe line, the expected increase in production from Eastern Venezuela should soon be realized. Exploratory work is being carried on with tests located in the territory north of the Orinoco River and extending westward from its delta. Production from Eastern Venezuela during 1938 was 29,642,000[1] bbl. as compared to 160,590,000 bbl. from Western Venezuela. Whether or not any fields comparable to those on Lake Maracaibo will materialize cannot, of course, yet be predicted.

There are at present three fields shipping oil from Eastern Venezuela—Quiriquire, Padernales, and Temblador. Crude oil from these fields is loaded on tankers, which then go to the terminal at Guiria where the oil either is transferred to other tankers, is put in storage at the tank farm, or is added to for further transportation inasmuch as deep-draft ships cannot be loaded to full capacity at the river loading terminals to which oil from the fields is directly delivered.

During early 1938, it was necessary to lay a submarine line at Guiria to replace two older lines. To reduce trouble from wind and tidal conditions in the outer berths, the new line was pulled to a 25-ft. depth, which was considered a safe depth to permit shuttle tankers to berth. The new line was pulled into place in the record time of 19 minutes.

Shipments from the Oficina field will be made from the Gulf terminal at Guanta, Puerto La Cruz, on the Caribbean Sea, upon completion of the line from the field to this port.

In addition to the shipping fields of Eastern Venezuela there are several fields and wells that are productive but have produced but little oil because of the lack of shipping facilities. A pipe line will shortly connect one of these

[1]Figures given for 1938 and up to the end of 1938 are taken from A.I.M.E. *Petroleum Development and Technology*, 1939, when not supplied by oil companies. Other figures used in this article were supplied by oil companies.

Oil loading dock at Caripito. Construction is of creosoted pile and timber

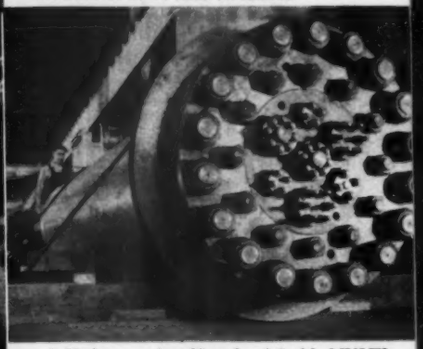
Again Smith Solves the Problem

MULTI-LAYER

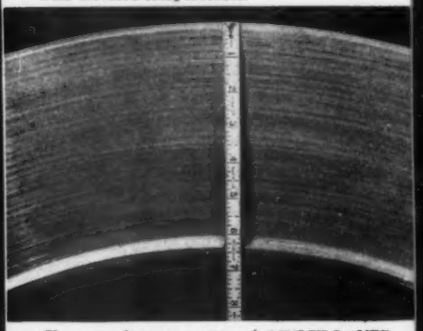
STEEL PLATE CONSTRUCTION

Provides Full Calculated Strength in Small-diameter Thick-walled Pressure Vessels

General view of one of the world's largest Recycling Plants on the Gulf Coast. The Main Separator, of Smith MULTI-LAYER Construction, was built for an operating pressure of 2,000 pounds per square inch, with an inside diameter of more than 50 inches.



A Hydrogenation Vessel, of Smith MULTI-LAYER Construction, approximately 20 feet long, built for high pressures in combination with elevated temperatures.



Close-up of a cross section of a MULTI-LAYER shell made of 3/16-in. steel plate, having a total thickness of more than six inches.

Smith MULTI-LAYER Process Vessel for high pressure and temperature. The inside layer is made of polished alloy steel for corrosion resistance.

AT LAST a construction that provides full calculated strength for diameter-thickness ratios of ten or less . . . Smith MULTI-LAYER Construction. It gives industry its first dependable safeguard in the selection and operation of thick-walled, high-pressure vessels of small diameter, because it eliminates, for the first time, the element of ignorance in calculating their actual strength.

MULTI-LAYER Construction is the result of experience and knowledge gained in testing to destruction more than 20 full-size vessels during the past ten years, including nine vessels with a diameter-thickness ratio of less than ten.

Today, Smith MULTI-LAYER High-pressure Vessels are satisfactorily serving the oil and process industries under pressures up to 5,000 pounds per square inch.

MULTI-LAYER Construction eliminates old limitations on length and weight for small-diameter, thick-walled vessels. Where required for corrosion-resisting purposes or as protection against hydrogen attack, the inside layer may be either Smith-lined or made of solid alloy.

In the Interest of SAFETY—Send for This Bulletin. In the interest of safety, it is important to the users of pressure vessels with low D/t ratios to read Bulletin No. 221. Sent upon request. Write A. O. Smith Corporation, Milwaukee, Wisconsin. Offices at: New York, Pittsburgh, Chicago, Tulsa, Dallas, Shreveport, Houston, Corpus Christi, Los Angeles.

SMITH PRESSURE VESSELS

A.O.SMITH

CORPORATION

Milwaukee, Wisconsin

PIONEER MANUFACTURERS OF ELECTRIC-WELDED

Pressure Vessels

Casing · Line Pipe

Warehouse and yard, Padernales. Customs warehouse building is shown in center

areas, Jusepin, to the terminal at Caripito.

Quiriquire Field

The largest production and greatest number of wells drilled in Eastern Venezuela during 1938 are credited to Quiriquire, and this field showed but a slight decline from the previous year. There were 43 wells completed during 1938, bringing the total completed to the end of the year to 267.

This field, operated by Standard Oil Company of Venezuela, is divided into two segments by a north-south fault. The structure is monoclinal and production is obtained from various producing horizons ranging from 100 to 1400 ft. in thickness. The oil zones are lenticular and composed chiefly of fine and coarse sands. These are rather unconsolidated and contain cobbles and boulders and intercalations of shales and sandy shales.

Most of the oil comes from the east segment where the two producing zones are separated by shale beds and where, in most cases, twin locations are employed to take the oil from each zone through a different well.

Drilling operations for the year 1938 are summarized on this page.

During the last year, records were established for drilling time in both segments. One twin location was drilled in the east segment in 34 days and a well in the west segment was completed in 16.66 days. The best time made on dismantling at one location, moving to another location, and there rigging-up was 30 hours. The fastest time made in skidding from one well to the other on a twin location was 2½ hours. The reduced drilling time has resulted from improvements in drilling equipment and other important factors.

DRILLING OPERATIONS IN QUIRIQUIRE FIELD, 1938

	East Segment		*West Segment*	*Total*
	Upper Zone	*Lower Zone*		
Total footage drilled	43,817	61,205	15,653	120,675
Total footage cored	386	1,603	607	2,596
Total footage drilled and cored	44,203	52,808	16,260	123,271

Coring has decreased as the field has developed and this decrease per well completed during the last 5 years has been as follows:

Year	*Average footage cored per well*
1934	460
1935	357
1936	162
1937	95
1938	61

The other important factors contributing to great drilling speed are outlined briefly below:

(a) 10-in. by 10-in. drilling engines were replaced by 12-in. by 12-in. engines, resulting in a saving in down-time for engine repairs, reduction in oil consumption, and increased power.

(b) Introduction of the use of a set of steel settling and suction pits, 3 ft. by 4 ft. by 20 ft. long.

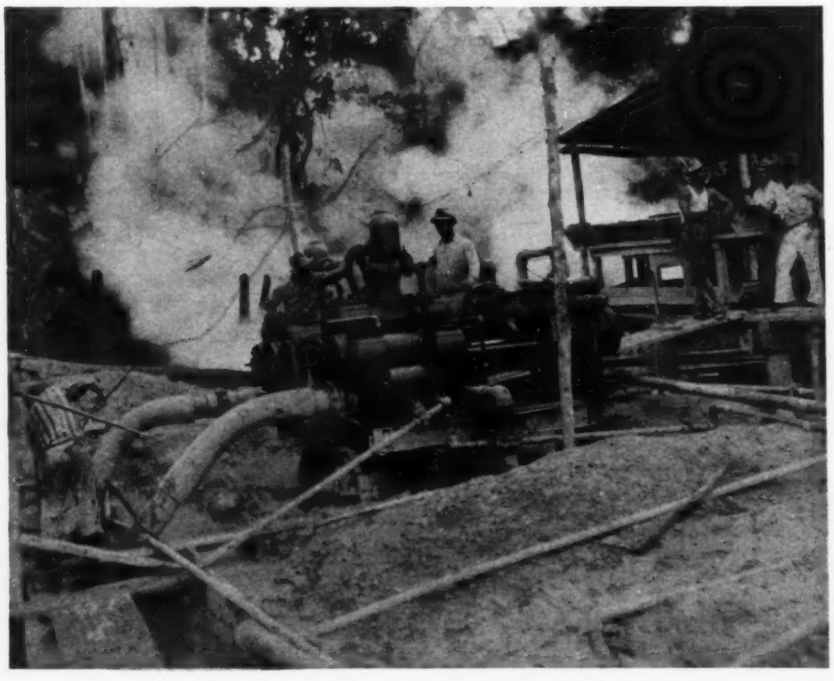
(c) All rigs were equipped with rapid-assembly engine sheds made of discarded drill pipe and corrugated iron, resulting in a saving in erecting and dismantling time.

(d) The construction and use of four 9-ft. by 24-ft. by 7-ft. high portable houses for cement storage made of discarded pipe and either tank plates or corrugated iron and mounted on Athey wagons.

(e) The use of 10-ft. sections of high-pressure rotary hose between the slush pumps and stand pipe has proved successful in reducing vibration and rigging-up time.

(f) Progress has been made in bit-dressing practice. Forging of used bits is now reduced to a minimum.

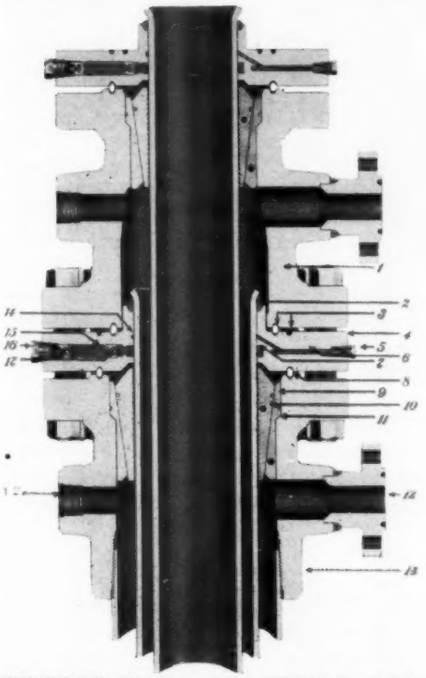
(Continued on Page 136)



Pump unit mounted on an Athey wagon supplying mud to drilling well in Quiriquire field. This unit remains in place for the drilling of both wells at a twin location

-IZE"

AINST DESTRUCTIVE WELL PRESSURES!



CAMERON TYPE "M" CASING HEAD

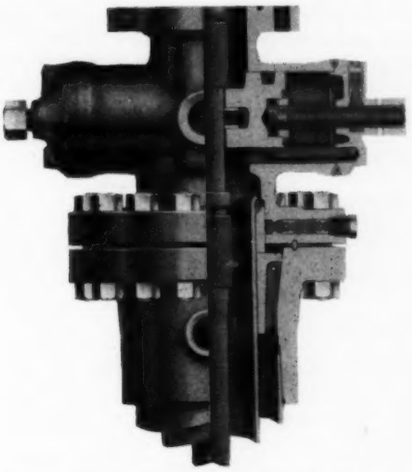
Cameron Type "M" 6000 lbs. test Casing Heads and Spools, as the foundation for Cameron Safety Christmas Trees, provide the "last word" in convenience, safety, speed of installation, and pre-tested efficiency under pressure. They provide for slip suspension of casing strings at any desired point in the hole. Seal of the space between strings is accomplished by a heavy construction weld, which prevents pipe from sagging into slips and swaging, and also prevents pipe from rising. Seal between flanges is by means of standard A.P.I. steel ring gaskets. An ingenious provision is made for visually testing each construction weld with hydraulic pressure, thus insuring pressure-tightness before installing casing spool or Christmas tree. As illustrated above, hydraulic pressure is applied through a port in the welding flange to exert pressure between the weld and the recessed asbestos ring; the asbestos ring having been forced to seal around the pipe by means of plastic packing introduced from the opposite side of the welding flange. Complete details will gladly be forwarded to interested operators on request.

Reference to figures above: 1. Spool, 2. Weld, 3. Standard A.P.I. ring groove, 4. Type "M" Welding Flange, 5. Pipe Plug, 6. Hydraulic test port, 7. Moulded asbestos seal ring, 8. Standard A.P.I. ring groove, 9. Split and doweled slip-bowl, 10. Split and doweled slips, 11. 45-degree tapered supporting shoulder, 12. Flanged or screwed outlets, 13. Casing head housing, 14. Half-round test groove, 15. Plastic packing port, 16. Pipe plug, 17. Ball-check type Allen set screws.

Cameron Type "G" Circulating Anchor Packer

The Cameron Type "G" Circulating Anchor Packer is extremely simple in design and operation. There are no slips, "J"-tools, or other complicated mechanisms. The packer is set by simply letting off part of the weight of the tubing string. When screen is made up in the anchor pipe below the packer, the entire assembly may be pulled from the well at any time it may be desired to kill the well for plugging back, re-perforating, etc. Should screen be stuck, tubing may be rotated loose directly below the packer, and the tubing and packer pulled from the hole. Screen and anchor pipe may then be washed over and pulled with little trouble or expense. In wells in which the oil string is cemented through the producing sand, and the casing is perforated, a Cameron Type "G" Circulating Anchor Packer may be relied upon implicitly to effect a pressure-tight seal between tubing and casing.

Due to their simplicity of design, ease of setting, and unfailing self-feeding valve packing element, Cameron Type "G" Circulating Anchor Packers have earned an enviable reputation in many of the deepest, highest pressure Gulf Coast fields, having effectively sealed off bottom hole pressures as high as 6300 lbs.

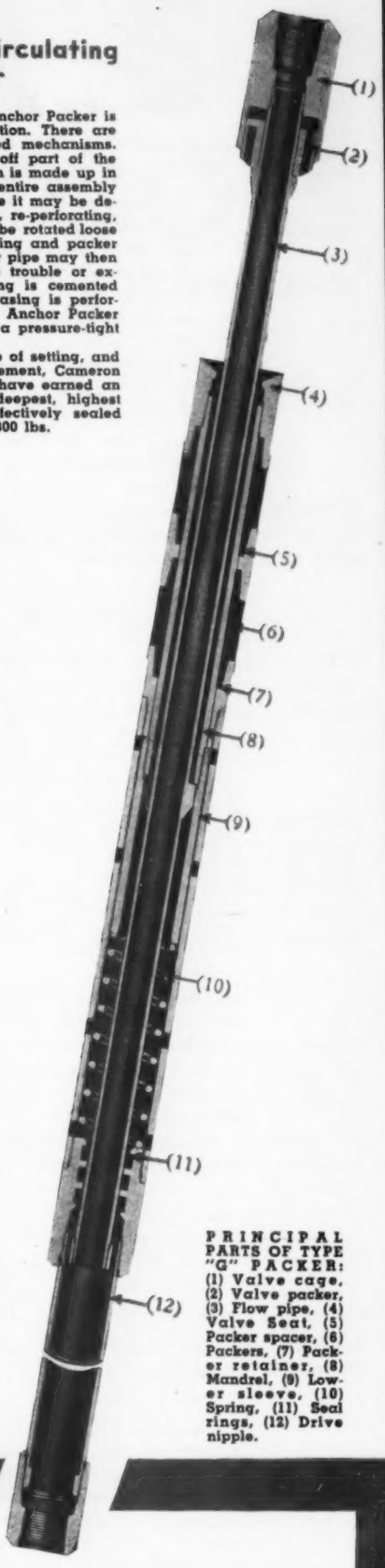


Cameron Type "LD" Control Head

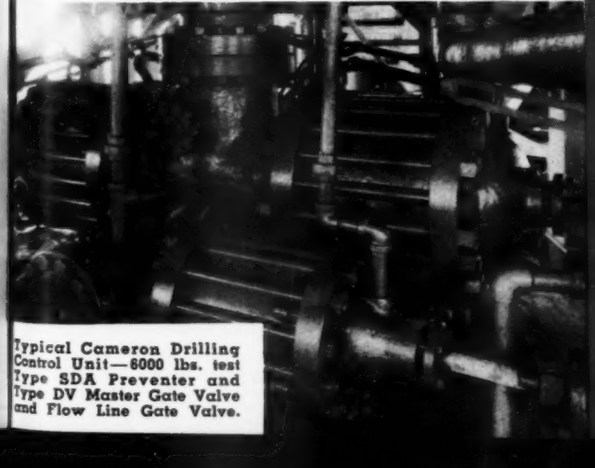
The Cameron Type "LD" 4000-6000 lbs. test tubing Control Head, employing numerous advantages of the heavier Cameron Control Heads, plus an ingenious means of effecting a seal of the annular space between casing strings, was developed to provide the ultimate in positive control at every stage of the completion work. The above cross-section drawing, showing a Type "LD" Control Head installed above a Cameron Type "O" Casing Head, illustrates the locked suspension and sealing of tubing with special hanger nipple on closed rams of control head. Note that seal of the annular space is accomplished by introducing plastic packing through a port in the lower flange of the control head, which forces a moulded asbestos ring, recessed in the lower flange, out against the welding bushing. Additional packing ports are located around each ram thrust screw to provide a repackable seal behind the rams, and thus eliminate necessity of conventional stuffing boxes.

The Cameron Type "LD" Control Head is also available without the annular space seal feature for use with Cameron Types "M" (see illustration at left) and "J" Casing Heads and Spools.

When used as the foundation for Cameron Safety Xmas Trees, the Type "LD" Control Head provides: (1) Positive blowout protection while drilling in and setting liner or screen with drill pipe or tubing. (2) Complete safety while washing well high outside of screen. (3) Sealing and suspension of tubing with special hanger nipple on closed rams of control head. (4) Safe re-entry of the well for re-working under pressure, without killing.



PRINCIPAL PARTS OF TYPE "G" PACKER: (1) Valve cage, (2) Valve packer, (3) Flow pipe, (4) Valve Seat, (5) Packer spacer, (6) Packers, (7) Packer retainer, (8) Mandrel, (9) Lower sleeve, (10) Spring, (11) Seal rings, (12) Drive nipple.



Typical Cameron Drilling Control Unit—6000 lbs. test Type SDA Preventer and Type DV Master Gate Valve and Flow Line Gate Valve.

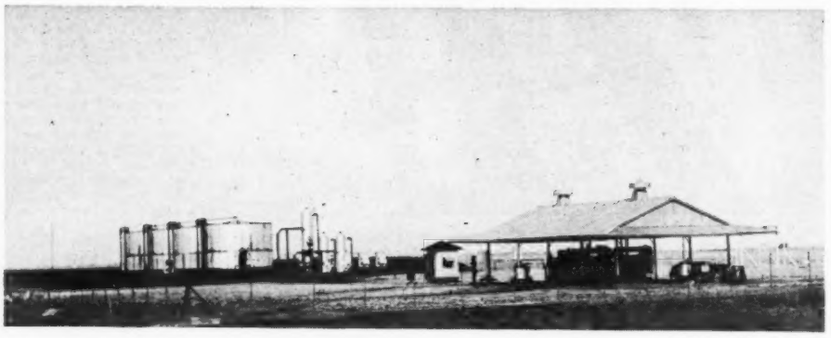
CAMERON IRON WORKS, INC.

711 MILBY ST., HOUSTON, TEXAS

California Distributor: The Howard Supply Co., Los Angeles

Export—74 Trinity Place, New York, N. Y.

Pumping station, Temblador field



(Continued from Page 132)

The worn cutting edge is cut off and rebuilt by welding rod and half-round hard-facing inserts, placed parallel to the axis of the bit. The acetylene torch has been used in this work exclusively. The merits of these methods are demonstrated by a sharp increase in footage obtained from the bit and in drilling speeds.

(g) Four-wing drag bits have been used extensively in the softer formations. An absence of crooked hole problems in this district and an increase in footages and speeds have resulted.

(h) Rock bits of 2-cone and 3-cone type have been used.

(i) Drill-pipe records were kept on the various strings in the field. In one instance, more than 53,147 ft. of hole had been drilled with a string of 4½-in. drill pipe and it was still in good condition.

Wire-line service has been studied and recommendations made for different types of service. Improvement has been noted by using tarred paper sacks for shipping cement; hydrolysis of cement in storage has been reduced. Designs of flow stations and Christmas trees have been improved.

An equipment standardization engineer makes studies of all producing and drilling equipment; and equipment specifications developed and approved by an equipment committee serve as a standard guide in the purchase of suitable equipment.

A summary of the gas operations in Quiriquire for the year 1938 is as follows:

Gas produced	*M. cu. ft.*
Daily average	25,807
Total for 1938	9,419,584
Total to date	31,880,508
Gas returned to formation	*M. cu. ft.*
Daily average	5,326
Total for 1938	1,943,863
Total to date	9,870,815

Gas is returned to the producing horizon of the field continuously at the average rate of 5,326,000 cu. ft. per day. This volume represents 20.64 percent of all the gas produced. Since early in 1938, gas has been injected through three wells. Two of these wells, completed in the gas cap of the northern part of the field, have been used in continuous return of gas during the last three years. A third well, in the south central part of the east segment of the field, was converted to an input well in an effort to check the declining pressure in that area. Distribution of gas injection during the last two years and totals injected to date in all input wells are as follows:

Gas Injected, M. cu. ft.

Input well	1937	1938	*Total to date*
A			76,584
B			1,872,794
C			1,997,460
D			181,965
E	576,551	557,651	1,651,542
F	1,462,284	1,191,464	3,895,720
G		194,750	194,750
Total	2,038,835	1,943,865	9,870,815

Pressure decline on wells adjoining the gas cap area in the north is much less than wells farther down structure. This retarded decline is partly attributed to return of gas through the first two wells mentioned. Several wells are showing increasing gas-oil ratios and at present several wells are closed-in because of high gas-oil ratio. Returned gas is advancing down dip but it is doubtful whether the expanding gas is moving uniformly in all the lenticular sand bodies in the producing section.

Four additional compressor units have been installed in the central compressor plant. These units were in operation during the first part of 1939. With the 14 units operating, the capacity of the plant will be about 9,000,000 cu. ft. per day and will provide sufficient gas for gas-lift and repressuring projects. In connection with the installation of the additional compressors, an auxiliary building for housing three additional pumps and their prime movers, a standby air compressor, and the two units of the electric power plant have been installed.

Two subsurface pressure surveys were made during 1938. The west segment showed little change in average subsurface pressure. Pressures are closely checked to detect areas of pressure drop.

Padernales Field

The Padernales field lies on the southeastern shore of the island of Cotorra and extends to the mainland of the delta of the Orinoco River. Some of the wells along the Cotorra shore are water locations; others are water-and-land operations.

A loading terminal for shallow-draft tankers has been built at Capure. The oil is taken by these tankers to Guiria. Tankage at Capure consists of two

High water stage at Boca de Uracoa, terminal of the pipe line from the Temblador field

CAVINS

"Performance-Plus" TOOLS

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

CAVINS AUTOMATIC HYDRAULIC SUCTION BAILER

(Fig. 1)

For breaking hard packed sand bridges in casing and tubing; cleaning out below tight places in partially collapsed casing; fishing out movable pieces of junk; cleaning out around and inside of stuck tubing, etc., prior to running a spear or socket; removing gravel tamp and shattered formation from shot wells.

CAVINS ROD TYPE SAND PUMP

(Fig. 2)

For general production clean-out work under practically any well condition, it is especially effective in wells having low fluid levels (less than 500' of static head), or where it is not desired to flush the perforations while cleaning out.

CAVINS CABLE TYPE SAND PUMP

(Fig. 3)

An all-purpose tool for straight production work in light or medium gravity oil or water, or in connection with cable tool drilling where quick change-over to tools is desired. Load tube equipped with either Cavins-Candee bottom or Cavins two-way flapper valve bottom.

CAVINS SCREEN CLEANER

(Fig. 4)

A special attachment in combination with the Cavins Bailer that makes the fluid in the well drive back the mud and sand that had closed the openings —not much more than a bailing operation. It makes the well fluid open the screen without removing screen from the well. It uses a force more effective than having the liner out of the well, connected to a high pressure pump and directing the hydraulic force against the clogged openings outwardly, a small section at a time.

CAVINS PERFORATION WASHER

(Fig. 5)

May be analyzed as a Cavins Bailer plus (1) equipment to open valve to take load any place desired by starting out of the well, and (2) a shoe that concentrates the full force of the fluid weight out against one clogged opening and back in against the next one to positively open the holes. These operations are directed only where desired—at the oil strata. The fluid then jets through the previously opened holes against the formation at each operation to wash it into the tool or let it settle into the well bottom. Where a fluid head exists and productive zone is known, this simple tool is the quickest way to increase production.

CAVINS TUBING SWAB

(Fig. 6)

Maximum fluid by-pass through the mandrel assures more trips per hour and eliminates the hazard of the swabbing string being blown up or out of the tubing. Double length of life of our rubbers is common through positive mechanical expansion.

CAVINS PERFORATION SWAB

(Fig. 7)

Designed for low pressure perforation washing, this tool directs a series of fluid jets directly against the perforations. A decrease in load on the pulling unit indicates when the perforations have been flushed open or when blank pipe has been reached.

Write for illustrated descriptive bulletin on each Cavins "Performance-Plus" Tool

The CAVINS Company

2853-73 Cherry Avenue — Long Beach, California

Cable Address: "Cavins, Long Beach"

Foreign Representative: R. J. Eiche

Branches and Service Representatives Maintained at:

CALIFORNIA: Bakersfield, Taft, Ventura — LOUISIANA: Lake Charles, Shreveport

KANSAS: Great Bend and Hoisington — OKLAHOMA: Ada

TEXAS: Corpus Christi, Houston, Kilgore, Odessa

Oil loading station, Capure Island

82,000-bbl. tanks and one 20,000-bbl. tank. Pumping facilities include two engine-driven centrifugal pumps designed to load at a rate of 6000 bbl. per hr.

A summary of drilling activities in this field follows:

Drilling Operations in Padernales Field, 1938	
Total footage drilled	25,305
Total footage cored	921
Total footage drilled and cored	26,226

Drilling has been done by two rigs, one Diesel-electric unit and one steam-driven unit.

The casing program used in each of five wells completed in 1938 consisted of:

18⅝-in.— 200 ft.
13⅜-in.—1000 ft.
9⅝-in. (oil string)—length depending on depth to top of producing zone.
4¾-in. liner.

In two wells the setting of 13⅜-in. casing was required to seal-off a series of loose, unconsolidated beds, the material of which had thinned the mud and thus caused several fishing jobs. Because of excessive pressures encountered in the oil zone and the apparent ease with which the mud becomes dangerously gas-cut, the producing horizon is penetrated using mud whose weight is not less than 14 lb. per gal. in the hole.

Minor changes in location, preparation, and rig equipment have facilitated the work of moving and have also reduced the cost of rigging-up at each location. One example of this was the redesigning of the hydraulic brake tower support so that four 100-ft. creosote piles could be eliminated.

The gas operations at Padernales for the year 1938 were as follows:

Gas produced	*M. cu. ft.*
Daily average	3,910
Total for 1938	1,427,122
Total to date	2,596,899

Initial pressures of all wells in this field are greater than the pressure due to hydrostatic head at producing horizons. Pressure decline is greater in new completions but becomes less pronounced after the well has produced for a short time.

Temblador Field

This field began commercial production in February, 1938, upon completion of the pipe line from the field to Boca de Uracoa. The field is operated by Standard Oil Company of Venezuela and the oil is shipped by shallow-draft tankers from Boca de Uracoa to the deep-water terminal at Guiria through Cano Manamo, which enters the Gulf of Paria directly south of the western part of the island of Cotorra.

This field is situated on a long narrow structure. During 1938, 41 wells were drilled in this field, bringing the total number of wells completed to the end of 1938 to 51. The gravity of the oil is from 21 to 23 deg. A.P.I. A summary of drilling operations during 1938 follows:

Drilling Operations in Temblador Field, 1938	
Total footage drilled	160,851
Total footage cored	2,641
Total footage drilled and cored	163,492

Drilling derricks including substructure are skidded from one location to another and the average rig move is made in 8 hours.

Production for 1938, which was not a full shipping year, was 2,295,000 bbl.

The gas operations in the Temblador field for 1938 were as follows:

Gas produced	*M. cu. ft.*
Daily average	2,660
Total 1938	970,867
Total to date	983,523

The pipe line from the Temblador field to Boca de Uracoa was completed in March, 1938. The first section of this line was laid across an inundated area between Tabasco and Boca de Uracoa early in 1937 in order to complete it before the land was flooded. Construction of the rest of the line was not begun until late in 1937.

At Boca de Uracoa terminal there are two tanks, each of 82,000-bbl. capacity. One berth was constructed for loading oil into shallow-draft lake-type tankers for transportation to Guiria. Pumping equipment for loading tankers at Boca de Uracoa terminal consists of two centrifugal pumps driven by Diesel engines, designed to load at the rate of 10,000 bbl. per hr.

(Continued on Page 142)

Constructing a submarine pipe line at Guiria. Two small buoys tied to the end of a tow line denote progress being made in pulling line into place

Volume Producer." Quick installation, simple design and maximum cross-sectional displacement are the outstanding features of this pump. A precision pump for use in large volume wells, it is long-wearing, easily serviced.

"*Petrol A.*" A low priced precision built pump for use in stripper wells, designed to reduce pumping costs to the core. Like all other FLUPACO Groove Seal Pumps, it conforms to A. P. I. specifications.

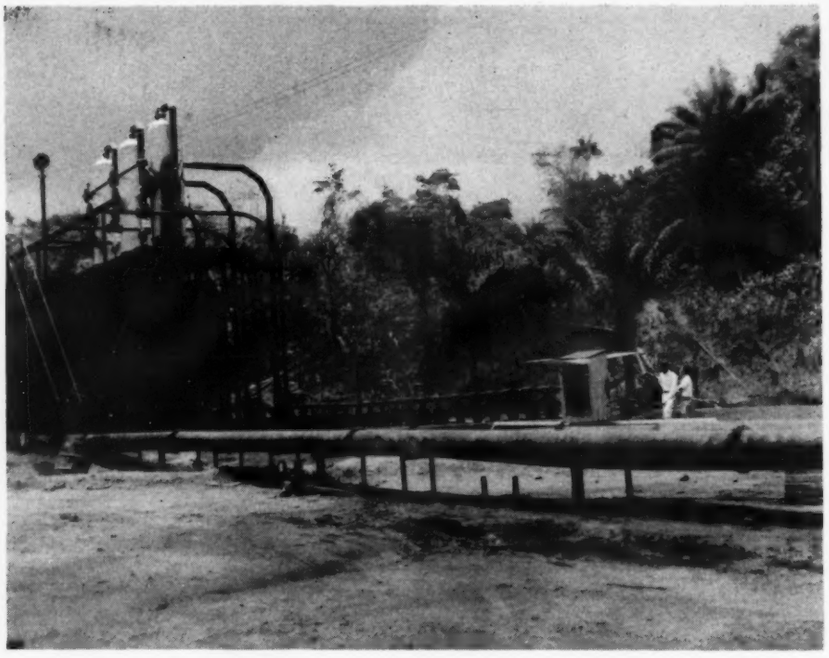
"*Producer.*" An insert pump for wells of medium volume and depth. Has plungers of "Service" or "Supreme" alloys—wear-resistant and durable. Also has largest cross-sectional area available in insert construction.

"*Positive Pull Type.*" For general pumping conditions, this pump is recommended wherever the insert feature is desired. The entire assembly goes in and comes out on the rods, giving positive pulling action.

"*Removable Type.*" This pump is equipped with a manually operated hook-on device that enables the operator either to pull the standing valve and seat or leave them in place when pulling the traveling tubes.

"*Rigid Type.*" Recommended for extreme sand or viscous oil conditions, this pump is securely anchored to prevent its pulling off the seat. Only the traveling tubes come out on the rods, assuring positive hold-down efficiency.

"*Marginal.*" For pumping marginal or low volume wells in which severe sand conditions prevail, this pump has all the features of the "Positive Pull" type, plus extremely low maintenance costs.



Manifold system and traps at pump station in Quiriquire field that pumps the production from 23 wells

ments has been taken from the wells already drilled.

Non-Shipping Fields or Wells

On the map of Eastern Venezuela there are shown a number of wells indicated as "Producing Oil Field or Well." Some of these may never have sufficient production to warrant the transportation of oil to shipping terminals or refineries in Venezuela. Some may find an outlet for their production and of these a few may be developed into important areas. Two or three fields or wells included in these areas and shown on the map as "Inactive Oil Field or Well" did not produce during 1938 but may be connected in the future to pipe-line outlets.

The Uracoa well was drilled by Standard of Venezuela for Mene Grande Oil Company about two years ago. Production from this well during 1937 was 16,741 bbl. and during 1938, was 6960 bbl. The oil has a gravity of 15 deg. A.P.I.

Just south of the Uracoa well is the Tabasco well drilled by Standard on a Pantepec Oil Company of Venezuela concession. This oil, too, has a gravity of about 15 deg. A.P.I. Very little oil was taken from the well during the last year.

Between Temblador and Oficina are the El Tigre wells of Mene Grande Oil Company. The first well has been inactive since being drilled and no reports of any production from it have been received. The second well was completed last year and is reported by J. A. Holmes[2] as having an initial produc-

(Continued from Page 138)

Oficina Field

Although no oil is being shipped from the Oficina field at the time of writing, oil will probably be moving before the end of 1939, through the new 16-in. pipe line to the Gulf terminal at Puerto La Cruz on the Caribbean Sea. Only two producers were completed during 1938 but drilling activity has been accelerated during 1939 and several wells have been drilled to test out the productive area and also be ready for production when crude shipments start. Gravity of the oil is reported to be from 17 to 40 deg. A.P.I.[2] from several possible producing sands that have been encountered.

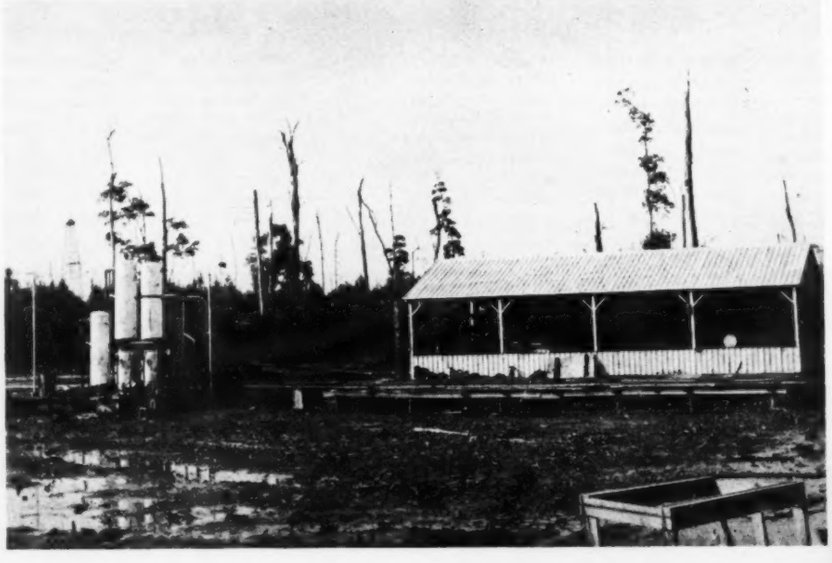
Equipment and supplies for operation of the Oficina field have been transported up the Orinoco River by ocean steamship to the Mene Grande Oil Company's warehouse at Las Penas across the river from Ciudad Bolivar. When unloading a ship, a barge is moored to the river bank as a receiving dock, and plank ramps are laid from the barge and up the beach to the warehouse yard. Trucks then pass down one ramp to the barge, are loaded by means of the ship's tackle, and pass up the other ramp to the warehouse yard where they are unloaded by a portable crane.

The warehouse and camp are connected by a road to Gulf's field terminal at San Tome at the northern end of the Oficina field. A road has also been built from San Tome to the deep-water terminal at Puerto La Cruz and along this road the new 16-in. pipe line was constructed. Puerto La Cruz is on a harbor just across the neck of a small peninsula from the city of Guanta.

Jusepin Field

Though but few wells have been completed in the Jusepin field, a line will soon connect it with the pipe line carrying oil from Quiriquire to the loading terminal on the San Juan River east of Caripito. Little is yet known about the productive area of this field. Only enough oil for local field require-

[2]From "Petroleum Development in Venezuela during 1938" by Joseph A. Holmes. *Petroleum Development and Technology, 1939.* Published by A.I.M.E., 29 W. 39th Street, New York, N. Y.



Cotorra gathering station, Padernales field

ONE HUNDRED MORE LIVES SAVED *right at the rig!*

Look at this rack of fifty or more doubles of drill pipe. There's *new* life, *new* safety and *new* efficiency in every tool joint box and pin... put there quickly and economically—*right* at the rig—with the Johnston Portable Tool Joint Refacer!

You can effect these savings on repair and replacement costs, too, by having worn tool joints on *your* drilling strings refaced with the Johnston Tool Joint Refacer. By means of a master gauge, this tool mounts directly on the threads of box or pin and recuts the face *in exact alignment with the threads themselves*, giving a precision job every time. The result is a joint that makes up as pressure-tight and smooth-shouldering as when new. Threads previously unused are now brought into play..."flat" joints make up in new position, protecting worn sides... and your drilling string again stands up under peak pressure loads!

And in overseas fields the Johnston Portable Tool Joint Refacer will save thousands of dollars in transportation and labor costs—costs otherwise incurred when renewing worn tool joints at the machine shop. The Refacer is sturdily built to stand the hardest use, yet it weighs only 150 pounds complete, is easy to carry in the field, and can be operated by one man. Where other electric power is not supplied, a small motor-driven generator is available for use with the tool.

The Johnston Refacer is sold outright for export use, either singly or in pairs. It is completely equipped with master gauges for thread and size of joint required. In California the Johnston Refacer is available on a service basis. Fully equipped service trucks bring the tool to your rig or pipe yard and trained operators do the work in a minimum of time and at reasonable cost. Call your nearest Johnston Service Branch today or write direct for illustrated descriptive folder!

M. O. JOHNSTON OIL TOOLS, Inc.

117 SAN FERNANDO ROAD, LOS ANGELES, CALIFORNIA, PHONE: ALbany 0186

BAKERSFIELD 2794 ★ VENTURA 5621

tion of 1392 bbl. per day at a casing pressure of 625 lb. and a tubing pressure of 340 lb.

Southwest of the El Tigre wells are the Merey wells, one of which was completed by Mene Grande as a small pumper during 1938. The first well was started some years ago and not completed until sometime in 1937. It has been shut-in most of the time since completion and what little oil was taken from it in 1938 was used for fuel.

The Areo well, slightly southwest of the Merey wells, was also drilled by Mene Grande. Production from it during 1938 was very small.

West of the Areo well and southwest of the Oficina field is the Yopales well drilled by Standard of Venezuela. A little oil was taken from this well during the last year.

Farther to the north, about 40 miles northwest of San Tome, are the Santa Ana wells drilled by Mene Grande.

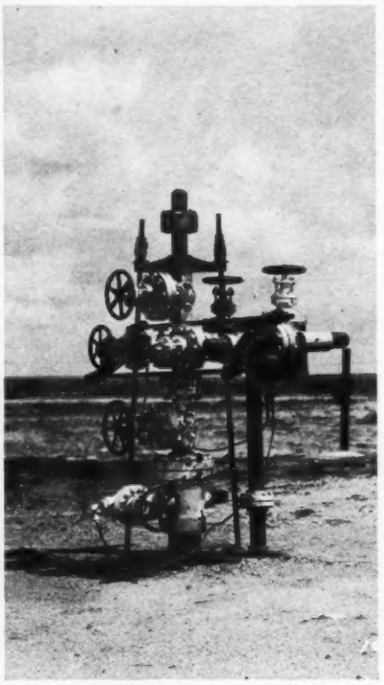
Inactive Oil Fields or Wells

Those wells indicated on the map of Eastern Venezuela as "Inactive Oil Field or Well" include tests in several areas. Northeast of Caripito are the Guanoco wells. This was a producing field until about six or seven years ago when it was closed in. Guanoco is one of the oldest fields in Venezuela, having been discovered by a shallow well in 1913. During its development, 24 wells were drilled, of which 14 were producers. Depths of production (from shale) ranged from 600 to 1200 ft. The oil was a heavy asphaltic oil of about 10 deg. A.P.I. and total production from the field was approximately 1,850,000 bbl. This project was an expensive one and is now closed down. No recent interest has been shown in this area. Just south of the Temblador field are the Pilon wells of Lago that were drilled by Standard of Venezuela.

West of the Pilon wells are the El Salto wells, drilled by Standard on a Pantepec concession. Farther to the southwest, and southeast of the El Tigre and Merey wells, are the two La Canoa wells of Standard of Venezuela.

Southwest of Quiriquire are the Orocual wells, which were drilled about six years ago. There are three of these wells, which have to date produced 30,000 bbl. of oil of 13 deg. A.P.I. gravity. They are now shut-in.

The area east of a line between Caripito and Maturin has been widely prospected but it has never yielded production in commercial quantities.



Wellhead connection in the Temblador field

The more important wells drilled here are indicated on the map. At Terreno Seco a well was drilled to a depth of approximately 8500 ft., and just north of the city of Maturin, four wells have been drilled, one to a depth of more than 8000 ft. These, together with the Lapica well, have been abandoned.

Southwest of Maturin, the El Lirial well, drilled by Standard on a Pantepec concession, is in much the same category as the wells mentioned above.

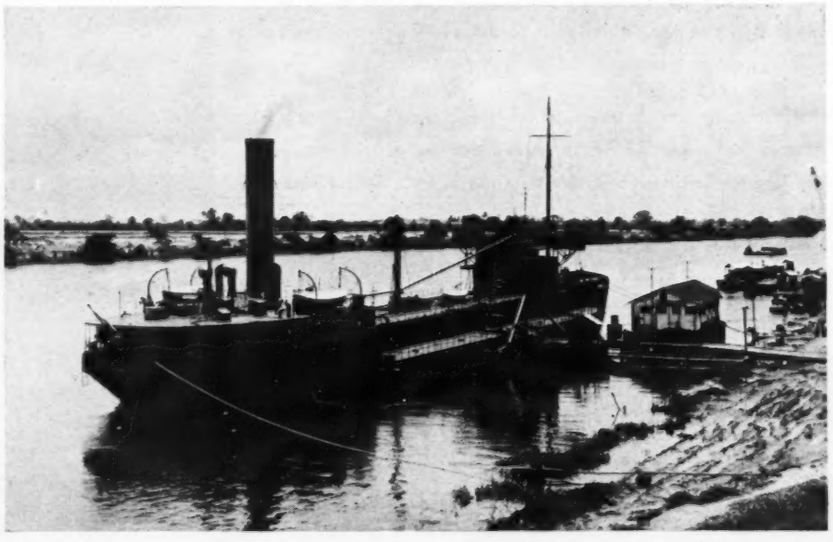
Exploratory Work in Eastern Venezuela

Geological and geophysical work and wildcat drilling, due to the dense jungle growth, is difficult and expensive. Test drilling operations must be preceded in almost all cases by solution of a transportation problem. The importance of the transportation problem is best emphasized in the development of the Oficina field for which equipment and supplies had to be carried by ship up the Orinoco River to a point opposite Ciudad Bolivar, there unloaded and sent overland 80 miles to the field. Similar trails have to be blazed to each new location.

Two wildcat wells have been drilled by Standard in the San Joaquin area between the El Roble and Santa Ana wells. Many problems were faced—entrance routes, clearing, camp construction, transporting materials and equipment, transportation facilities, and weather conditions. From Caripito to San Joaquin is 250 kilometers (155 miles) by road, some of which had to be constructed by the company. In several instances material had to be transported from Caripito to Las Penas (Ciudad Bolivar) by water. From Las Penas to San Joaquin the hauling distance is 200 kilometers (124 miles). Water for drilling is obtained from a nearby river and gas from the well, No. 2 Mene Grande Santa Ana. A water line 30 kilometers (19 miles) long from Rio Guanipa was completed early in 1939 to provide a supply of water for domestic and operating needs.

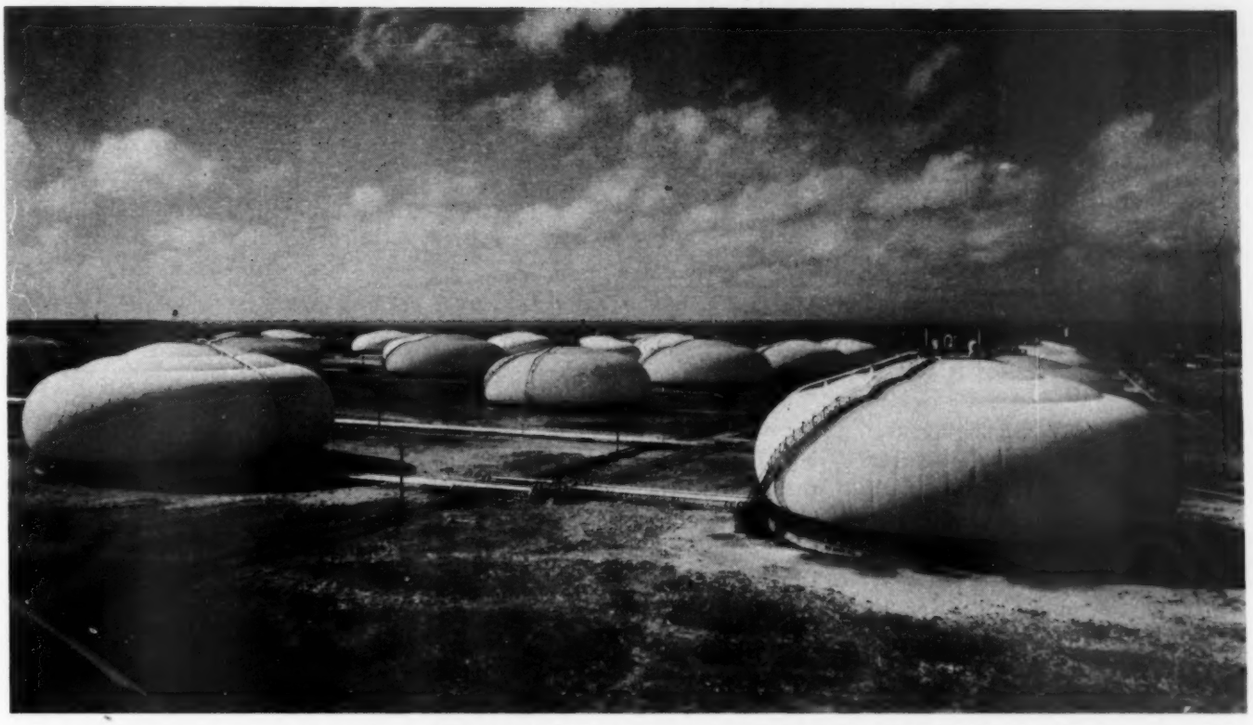
Just south of the Santa Ana wells, a wildcat of The Texas Company, is being drilled.

Of considerable interest because of their extension of the exploratory effort in Eastern Venezuela to the southwest are the Santa Clara and Carrizal wildcats. West of the Carrizal test are two wildcat wells, Nos. 1 and 2 Guayabo. No. 1 was abandoned and No. 2 is now drilling.



The steamship Ule lifting a cargo of crude oil from the terminal at Boca de Uracoa

P 129.
P 710.1



Hortonspheroid-tank field, Lago Oil and Transport Company, Aruba

Refineries on Island of Aruba Incorporate Modern Improvements

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Lago's 250,000-bbl. refinery and Arend's 22,000-bbl. plant constitute important part of South American refinery capacity.

By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

MUCH of Venezuela's great oil production is still exported as unrefined stock, the greater portion of which is processed on the island of Aruba. On Aruba there are two refineries, one of which is the largest in South America and has a capacity of between 240,000 and 250,000 bbl. per day. This plant is owned and operated by Lago Oil and Transport Company, Ltd., a subsidiary of Standard Oil Company of New Jersey. The other, situated on the northern end of the island, operated by Arend Petroleum Maatschappij, a Shell subsidiary, has a capacity of 22,000 bbl. per day. Aruba is one of the islands in the Caribbean Sea off the coast of Venezuela that form the Curacao Territory of the Netherlands West Indies. It is northwest of the larger island of Curacao on which is situated the 170,000-bbl. refinery of the Curacaosche Petroleum Industrie Maatschappij.

The conditions on the island of Aruba make the operation of the refinery a much more difficult problem than it would be if the vicinity possessed the necessary facilities for manufacturing processes. These facilities, ordinarily available to most refineries, have to be provided and maintained by the company. When the operations were begun, no housing, sanitary provisions, or other necessities were available. There were no suitable supplies of drinking water, food, or ice on the island and, though there was a small and properly-staffed hospital, its capacity was inadequate to provide for the needs of the influx of people from North America, Europe, and surrounding islands of the Caribbean. As a result, the company must bring drinking water in tankships from the United States and most of the food supplies, principally from the United States, are imported in refrigerated cargo space.

tion of 1392 bbl. per day at a casing pressure of 625 lb. and a tubing pressure of 340 lb.

Southwest of the El Tigre wells are the Merey wells, one of which was completed by Mene Grande as a small pumper during 1938. The first well was started some years ago and not completed until sometime in 1937. It has been shut-in most of the time since completion and what little oil was taken from it in 1938 was used for fuel.

The Areo well, slightly southwest of the Merey wells, was also drilled by Mene Grande. Production from it during 1938 was very small.

West of the Areo well and southwest of the Oficina field is the Yopales well drilled by Standard of Venezuela. A little oil was taken from this well during the last year.

Farther to the north, about 40 miles northwest of San Tome, are the Santa Ana wells drilled by Mene Grande.

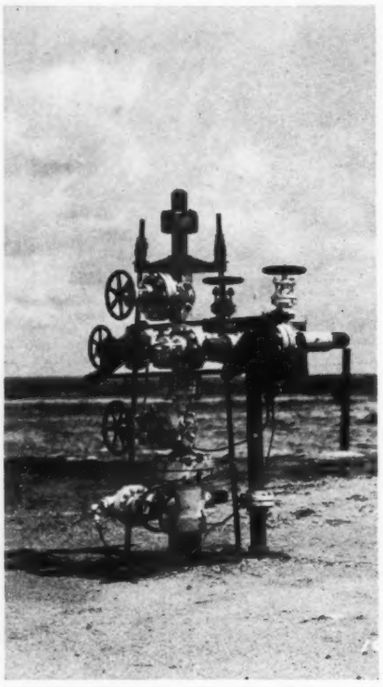
Inactive Oil Fields or Wells

Those wells indicated on the map of Eastern Venezuela as "Inactive Oil Field or Well" include tests in several areas. Northeast of Caripito are the Guanoco wells. This was a producing field until about six or seven years ago when it was closed in. Guanoco is one of the oldest fields in Venezuela, having been discovered by a shallow well in 1913. During its development, 24 wells were drilled, of which 14 were producers. Depths of production (from shale) ranged from 600 to 1200 ft. The oil was a heavy asphaltic oil of about 10 deg. A.P.I. and total production from the field was approximately 1,850,000 bbl. This project was an expensive one and is now closed down. No recent interest has been shown in this area. Just south of the Temblador field are the Pilon wells of Lago that were drilled by Standard of Venezuela.

West of the Pilon wells are the El Salto wells, drilled by Standard on a Pantepec concession. Farther to the southwest, and southeast of the El Tigre and Merey wells, are the two La Canoa wells of Standard of Venezuela.

Southwest of Quiriquire are the Orocual wells, which were drilled about six years ago. There are three of these wells, which have to date produced 30,000 bbl. of oil of 13 deg. A.P.I. gravity. They are now shut-in.

The area east of a line between Caripito and Maturin has been widely prospected but it has never yielded production in commercial quantities.



Wellhead connection in the Temblador field

The more important wells drilled here are indicated on the map. At Terreno Seco a well was drilled to a depth of approximately 8500 ft., and just north of the city of Maturin, four wells have been drilled, one to a depth of more than 8000 ft. These, together with the Lapica well, have been abandoned.

Southwest of Maturin, the El Lirial well, drilled by Standard on a Pantepec concession, is in much the same category as the wells mentioned above.

Exploratory Work in Eastern Venezuela

Geological and geophysical work and wildcat drilling, due to the dense jungle growth, is difficult and expensive. Test drilling operations must be preceded in almost all cases by solution of a transportation problem. The importance of the transportation problem is best emphasized in the development of the Oficina field for which equipment and supplies had to be carried by ship up the Orinoco River to a point opposite Ciudad Bolivar, there unloaded and sent overland 80 miles to the field. Similar trails have to be blazed to each new location.

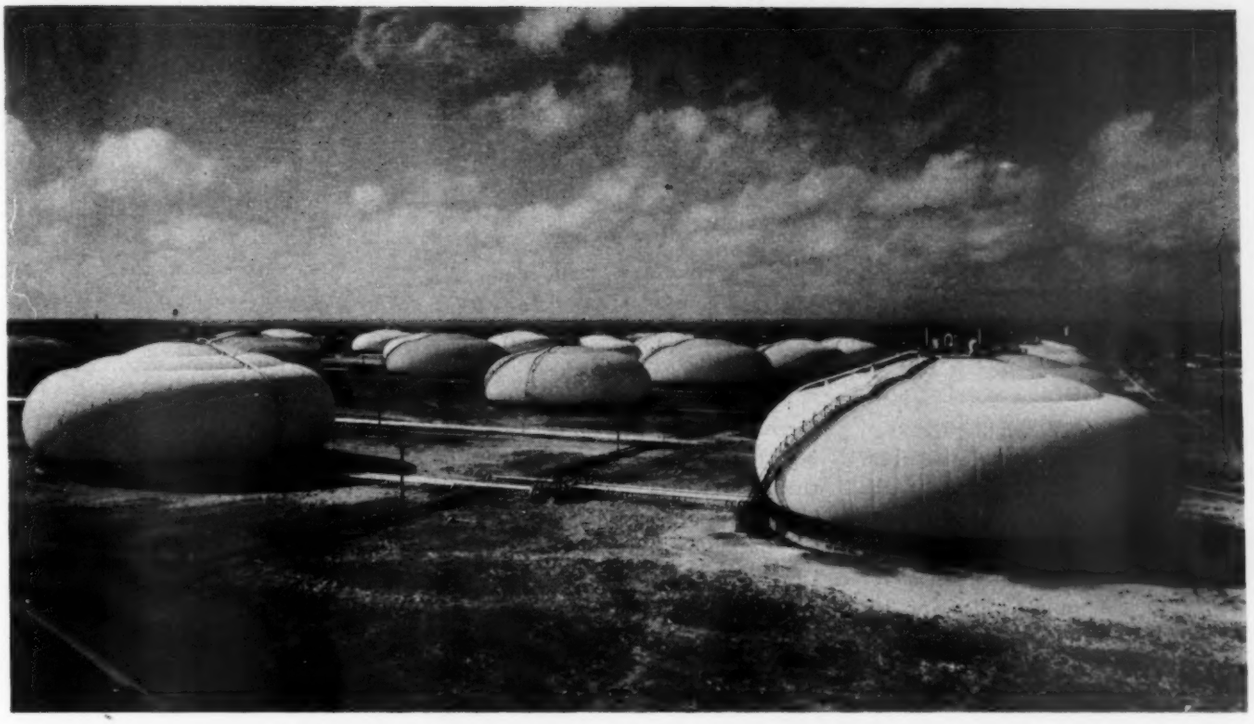
Two wildcat wells have been drilled by Standard in the San Joaquin area between the El Roble and Santa Ana wells. Many problems were faced—entrance routes, clearing, camp construction, transporting materials and equipment, transportation facilities, and weather conditions. From Caripito to San Joaquin is 250 kilometers (155 miles) by road, some of which had to be constructed by the company. In several instances material had to be transported from Caripito to Las Penas (Ciudad Bolivar) by water. From Las Penas to San Joaquin the hauling distance is 200 kilometers (124 miles). Water for drilling is obtained from a nearby river and gas from the well, No. 2 Mene Grande Santa Ana. A water line 30 kilometers (19 miles) long from Rio Guanipa was completed early in 1939 to provide a supply of water for domestic and operating needs.

Just south of the Santa Ana wells, a wildcat of The Texas Company, is being drilled.

Of considerable interest because of their extension of the exploratory effort in Eastern Venezuela to the southwest are the Santa Clara and Carrizal wildcats. West of the Carrizal test are two wildcat wells, Nos. 1 and 2 Guayabo. No. 1 was abandoned and No. 2 is now drilling.

The steamship Ule lifting a cargo of crude oil from the terminal at Boca de Uracoa

P 129.
P 710.1



Hortonspheroid-tank field, Lago Oil and Transport Company, Aruba

Refineries on Island of Aruba Incorporate Modern Improvements

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

Lago's 250,000-bbl. refinery and Arend's 22,000-bbl. plant constitute important part of South American refinery capacity.

By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

MUCH of Venezuela's great oil production is still exported as unrefined stock, the greater portion of which is processed on the island of Aruba. On Aruba there are two refineries, one of which is the largest in South America and has a capacity of between 240,000 and 250,000 bbl. per day. This plant is owned and operated by Lago Oil and Transport Company, Ltd., a subsidiary of Standard Oil Company of New Jersey. The other, situated on the northern end of the island, operated by Arend Petroleum Maatschappij, a Shell subsidiary, has a capacity of 22,000 bbl. per day. Aruba is one of the islands in the Caribbean Sea off the coast of Venezuela that form the Curacao Territory of the Netherlands West Indies. It is northwest of the larger island of Curacao on which is situated the 170,000-bbl. refinery of the Curacaosche Petroleum Industrie Maatschappij.

The conditions on the island of Aruba make the operation of the refinery a much more difficult problem than it would be if the vicinity possessed the necessary facilities for manufacturing processes. These facilities, ordinarily available to most refineries, have to be provided and maintained by the company. When the operations were begun, no housing, sanitary provisions, or other necessities were available. There were no suitable supplies of drinking water, food, or ice on the island and, though there was a small and properly-staffed hospital, its capacity was inadequate to provide for the needs of the influx of people from North America, Europe, and surrounding islands of the Caribbean. As a result, the company must bring drinking water in tankships from the United States and most of the food supplies, principally from the United States, are imported in refrigerated cargo space.

The company operates a large bakery and laundry and has recently completed a new hospital at a cost of $250,000. The hospital staff consists of six trained surgeons and physicians. Besides this medical staff there are laboratory technicians, X-ray operators, pharmacists, and a large staff of trained nurses.

It was also necessary to provide schooling for the children of the American and European employees, and the company-operated schools are now equipped to educate the children from the first grade through the usual high-school courses and prepare them for college. The attendance of the company school is in excess of 250 children. In addition to this the company gives assistance to the school for native children in the village of San Nicolas adjacent to the refinery concession.

The Aruba refinery operations employ approximately 5000 persons of whom about 800 are citizens of the United States, Canada, or European countries, engaged in executive, technical, and supervisory positions. The rest of the employees are from the Caribbean area, principally from the Netherlands West Indies and the English-speaking islands of the Lesser Antilles.

The Aruba organization is conducting an extensive program for the training of native boys and young men in the industrial trades; the Aruban boys in particular have shown excellent aptitude, particularly in the mechanical trades.

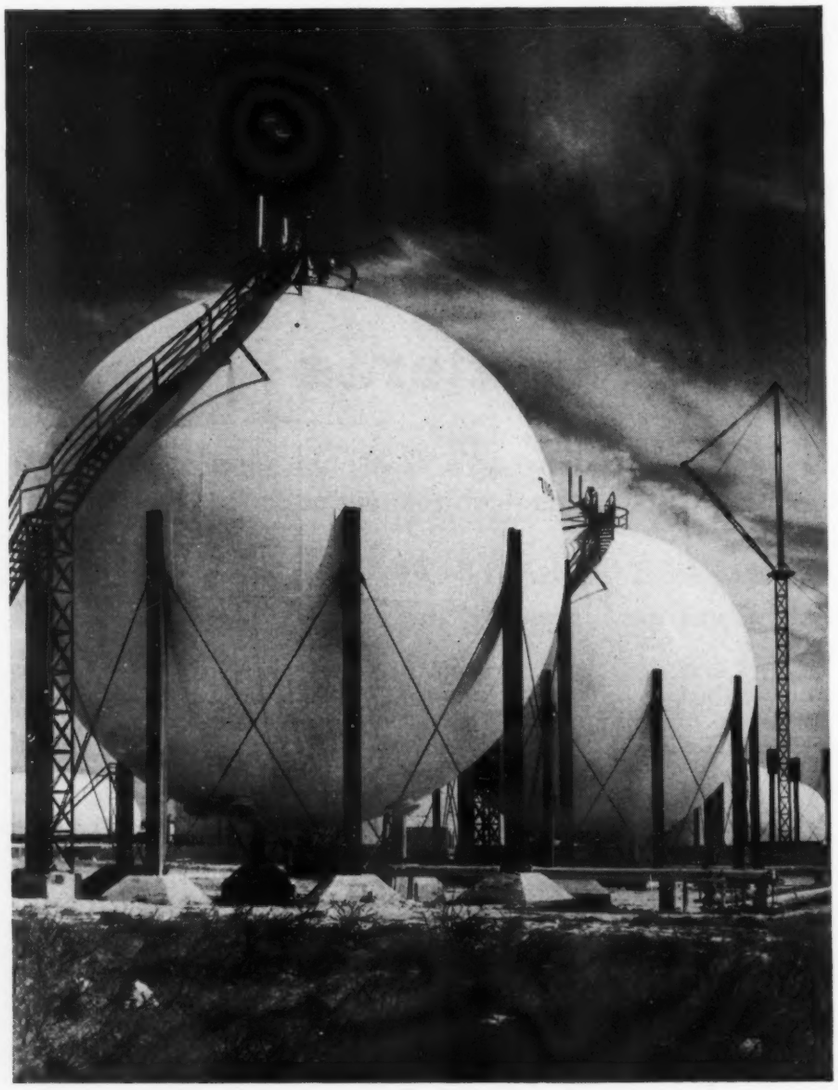
More than 400 houses of the bungalow type have been constructed by the company for housing its foreign staff employees. In addition, a large number of houses have been constructed for those native employees occupying the higher positions, and a plan has just recently been put into operation that will materially increase and stimulate the construction of better housing for all classes of native workers.

The harbor at Aruba has a working draft of 32-ft. mean low tide; besides numerous berths for small craft and Lake tankers, berthing facilities are provided for six ocean-going tankships simultaneously. The refinery has bulk storage for crude oil and finished products in excess of 10,000,000 bbl.

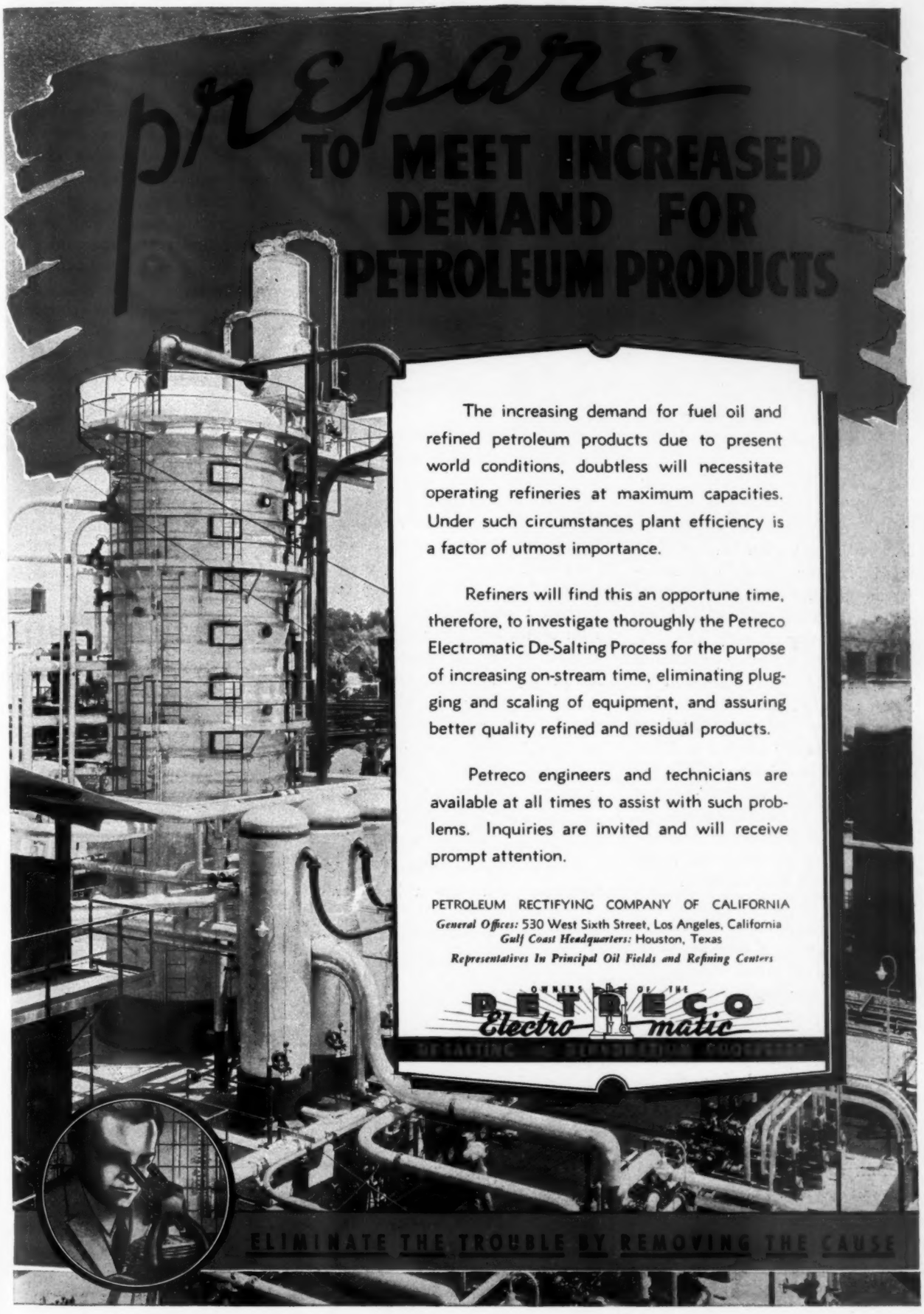
Lago Refining Operations

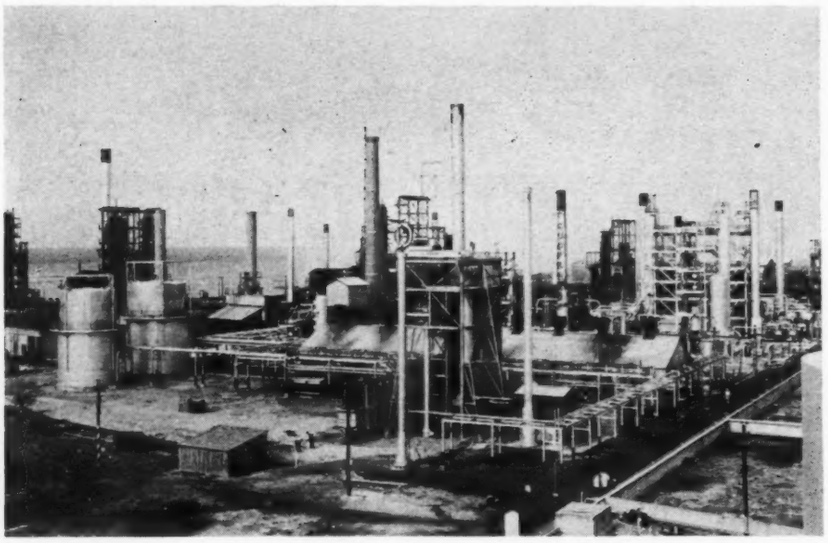
The Lago Oil and Transport Company, Ltd., refinery is completely electrified and obtains its electric power from a steam-electric power plant having a total of installed capacity of 41,000 kw. and a Diesel standby emergency plant of 5000-kw. capacity. At the present time the refinery has an average capacity of more than 240,000 bbl. daily and produces a great variety of finished petroleum products, consisting of many grades of naphtha, refined oils, high-speed Diesel oils, heavy marine Diesel fuels, and residual bunker fuel oils.

The original refinery consisted only of topping stills, combination cracking units, and acid-finishing facilities for the cracked naphthas. The present refinery has, supporting the cracking units and their attendant finishing facilities (which, as described, are primarily for the production of naphtha and Diesel oil), four atmospheric distillation units having a daily capacity ranging from 7,000 to 12,000 bbl. each, depending on service; a fifth atmospheric distillation unit having a capacity of 16,000 bbl. per day, and a two-stage atmospheric-vacuum distillation unit having a capacity of approximately 30,000 bbl. daily. These units are employed in various services, primarily for the production of such by-products as refined kerosene, high-



Hortonspheroid installation on the island of Aruba


prepare
TO MEET INCREASED DEMAND FOR PETROLEUM PRODUCTS
The increasing demand for fuel oil and refined petroleum products due to present world conditions, doubtless will necessitate operating refineries at maximum capacities. Under such circumstances plant efficiency is a factor of utmost importance.
Refiners will find this an opportune time, therefore, to investigate thoroughly the Petreco Electromatic De-Salting Process for the purpose of increasing on-stream time, eliminating plugging and scaling of equipment, and assuring better quality refined and residual products.
Petreco engineers and technicians are available at all times to assist with such problems. Inquiries are invited and will receive prompt attention.
PETROLEUM RECTIFYING COMPANY OF CALIFORNIA
General Offices: 530 West Sixth Street, Los Angeles, California
Gulf Coast Headquarters: Houston, Texas
Representatives In Principal Oil Fields and Refining Centers
PETRECO
Electro matic
ELIMINATE THE TROUBLE BY REMOVING THE CAUSE



Hydrogenation plant of Lago Oil and Transport Company

speed Diesel oils, and lube-oil base stocks.

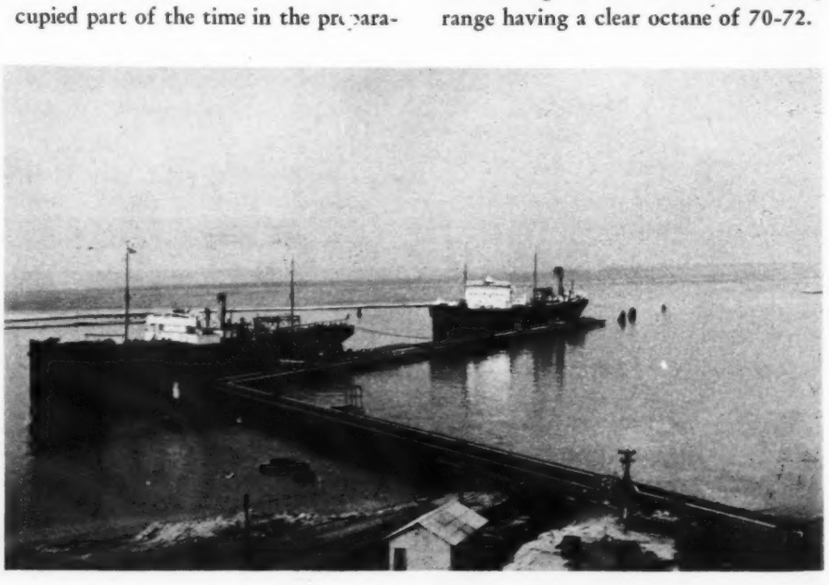
The combination atmospheric-vacuum distillation unit is operated principally on low-cold-test Colombian crude oil. This oil has inherent characteristics ideally suited for the manufacture of Diesel oils for high-speed engines and a low-cold-test, high-viscosity lubricating-oil stock. The high-speed Diesel oil is further processed to remove acidity and is finished in the Aruba plant for market. Because of its extremely low cold test, the oil has been found ideally adapted to Diesel engines used in aviation; in fact, the Graf Zeppelin uses and, before it was wrecked, the ill-fated Hindenburg had used Diesel oil produced at Aruba to the exclusion of all others. The Aruba refinery does not have facilities for the manufacture of finished lube oils and none is produced there, the lube-oil distillate from the Colombian crude being shipped to other refineries for finishing and blending.

The atmospheric distillation units are employed primarily in the processing of slightly lighter grades of crude oil of which the crude from the La Rosa field in Lake Maracaibo, of about 25-deg. gravity, is typical. These stocks are reduced to normal naphtha, kerosene, and gas oils, the bottoms from this operation going to the combination cracking units for the production of additional cracked naphtha and to lower the viscosity on fuel-oil residues. The natural kerosene or refined oil-cut is in itself somewhat inferior to the same grades of distillate from most Mid-Continent crude oils in the United States. To correct this deficiency in quality, Aruba has constructed a sulphur-dioxide extraction plant of the Edeleanu type, having a capacity to treat in excess of 10,000 bbl. per day of kerosene distillates. By this process, well-known to the industry, the unsaturates are extracted, leaving a finished kerosene of the highest possible paraffinicity and giving a highly superior burning quality as measured by the International Petroleum smoke-point test.

These atmospheric units are also occupied part of the time in the preparation of various asphaltic stocks from different specially-selected crudes and these stocks shipped to other refineries close to market outlets for final finishing. Aruba does not produce any finished asphalt for the trade because of the difficulty of transporting finished asphalt in bulk tankships and the expense that would be incurred in drumming the asphalt for transportation by regular cargo ship. For this reason, the base stocks are produced at Aruba and the asphalt is finished at points close to consumption.

Facilities were completed in 1938 at Aruba to permit the manufacture of aviation-base gasolines and aviation blending agents. The facilities for the blending agents consist primarily of units for extracting isobutylenes from the light ends of the various cracked-naphtha streams, passing these butylenes through a polymerizing process for the production of dimer and in turn hydrogenating the dimer into isoöctane, which is one of the best blending agents used today for the production of 100-octane aviation gasoline.

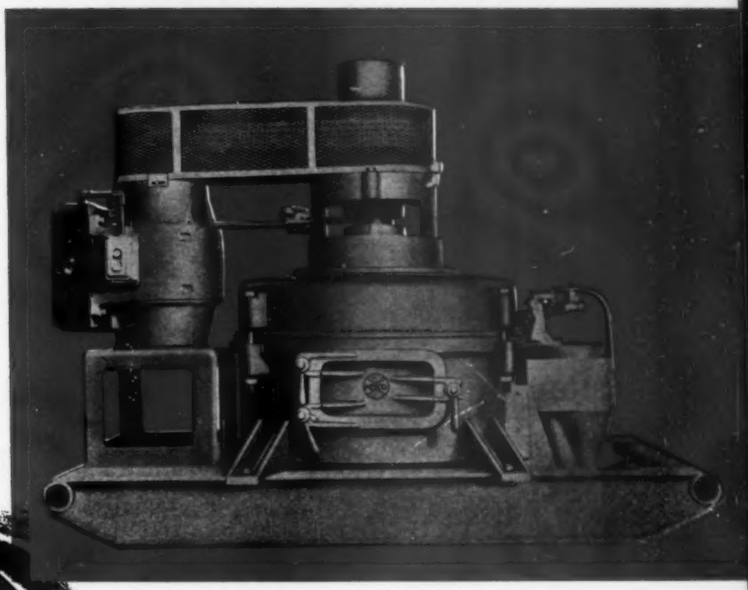
In addition to the facilities outlined above for the production of isoöctane, there is also being constructed the necessary sweetening, rerunning, and stabilizing equipment for fractionating from selected normal naphthas, a gasoline falling in the aviation boiling range having a clear octane of 70-72.



Gasoline-loading and utility docks

MAINTAIN SAND-FREE ROTARY DRILLING MUD

From START to FINISH of DRILLING OPERATIONS with the new *Cost-Saving* MERCO TYPE A-24 DESANDER



QUICKLY REPAYS LOW INITIAL INVESTMENT

A MERCO Desander is a profitable investment for large and small drilling operators. Low price—30 to 50% less than previous Mercos—and continuing low operating cost, place it well within the reach of every operator. Savings in wear on drilling equipment alone are enough to justify its low initial investment. Additional savings, in weighting materials and mud make the new Merco outstanding in value. Write for complete information and prices.

SAVES MONEY AND EXPENSE

- RECOVERS MUD-WEIGHTING MATERIAL
- KEEPS MUD CONDITIONED WITHOUT WASTE
- SAVES TRANSPORTATION COST OF MUD AND WEIGHTING MATERIALS
- REDUCES HAZARDS OF STUCK DRILL PIPE AND CASINGS
- ELIMINATES SAND-BLAST WEAR ON EQUIPMENT
- INEXPENSIVELY INSTALLED AND ECONOMICALLY OPERATED

Mud, with its costly weighting material, that has lost weight—become sandy and abrasive—need not be thrown away. To maintain the proper condition of mud employ the New Merco A-24 Desander. The Merco extracts substantially all sand down to 200 mesh—concentrates weighting material in mud, thereby reducing mud costs, weighting costs, wear costs.

The new Merco Type A-24 is lighter, smaller, more compact and less costly than previous types. It embodies all of the latest up-to-date refinements and improvements.

THE NEW IMPROVED

MERCO CENTRIFUGAL DESANDER

MERCO CENTRIFUGAL COMPANY
Division C, 343 Sansome St., San Francisco, Calif.

Write for *FREE BOOKLET*

"THE NEW IMPROVED METHOD OF CONDITIONING ROTARY DRILLING MUD"

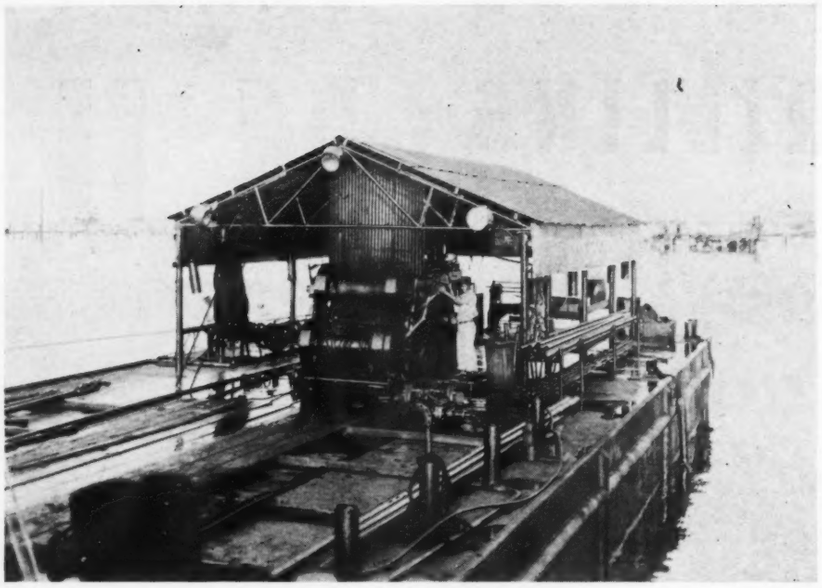
MERCO CENTRIFUGAL CO.
Dept. C, 343 Sansome Street, San Francisco, California.

Please send me without any obligation: ☐ Price of the New Type A-24 Desander; ☐ Information on Merco's New Process; ☐ Free Booklet on Conditioning Mud.

*Name*_____

*Address*_____

*City*_____ *State*_____



Electric-powered hoist mounted on barge for servicing wells

By
WALLACE A. SAWDON
Pacific Coast and Foreign Editor

Extensive development surrounding Lake Maracaibo represents firm entrenchment that will be difficult for new areas to surpass

Western Venezuela Maintains Leadership in South America

ALTHOUGH the spotlight has been turned on the newer fields of Eastern Venezuela, the greatest number of wells drilled as well as the greatest amount of production can still be credited to the Maracaibo Lake fields, or the Bolivar Coastal district. During the year 1938, more than 72 percent of the total oil produced in the country came from the Lake fields and 67 percent of the total number of wells drilled was put down in the development and extensions of these fields on lake and shore. To the end of 1938, the Lake fields had produced a total of 1,232,713,000 bbl. of oil,[1] and the total production from all Venezuela has been 1,685,615,000 bbl. The importance of the Lake fields is thus obvious.

Of the Lake fields (considering La Rosa as including Ambrosio and Punta Benitez) only Lagunillas produced less in 1938 than in 1937 but production from this field remained the largest from any single field. Development of the field continued with 97 wells being completed during the year. Of the two older Lake areas of Lagunillas and La Rosa, 1168 wells were completed by the close of 1938 in the former and 1213 in the latter.

The greatest increase in production was in the Tia Juana field, where development is going ahead rapidly. During 1938, there were 171 wells completed in this field, bringing the total to the end of that year to 439 wells. Shipments of oil from the newer Bachaquero field became active during 1938 and the field is now being rapidly developed, 26 of the total of 33 wells having been completed in the field at the end of the year.

Though it might seem that some of the Lake fields are arbitrary subdivisions of productive areas, the limits of all are defined by structural conditions.

Operations on the Lake

The Maracaibo Lake fields lie partly on land and partly below the water of the Lake. All drilling and production operations inland from the shore line are by the Venezuelan Oil Concession, Ltd., one of the Shell companies. Offshore and parallel to the general shoreline are strips approximately 1 km. wide that are operated by Mene Grande Oil Company, a Gulf Oil Corporation subsidiary. The drilling and production of all wells on the Lake except those located within the Mene Grande strips are by the Lago Petroleum Corporation, a subsidiary of Standard Oil Company of New Jersey.

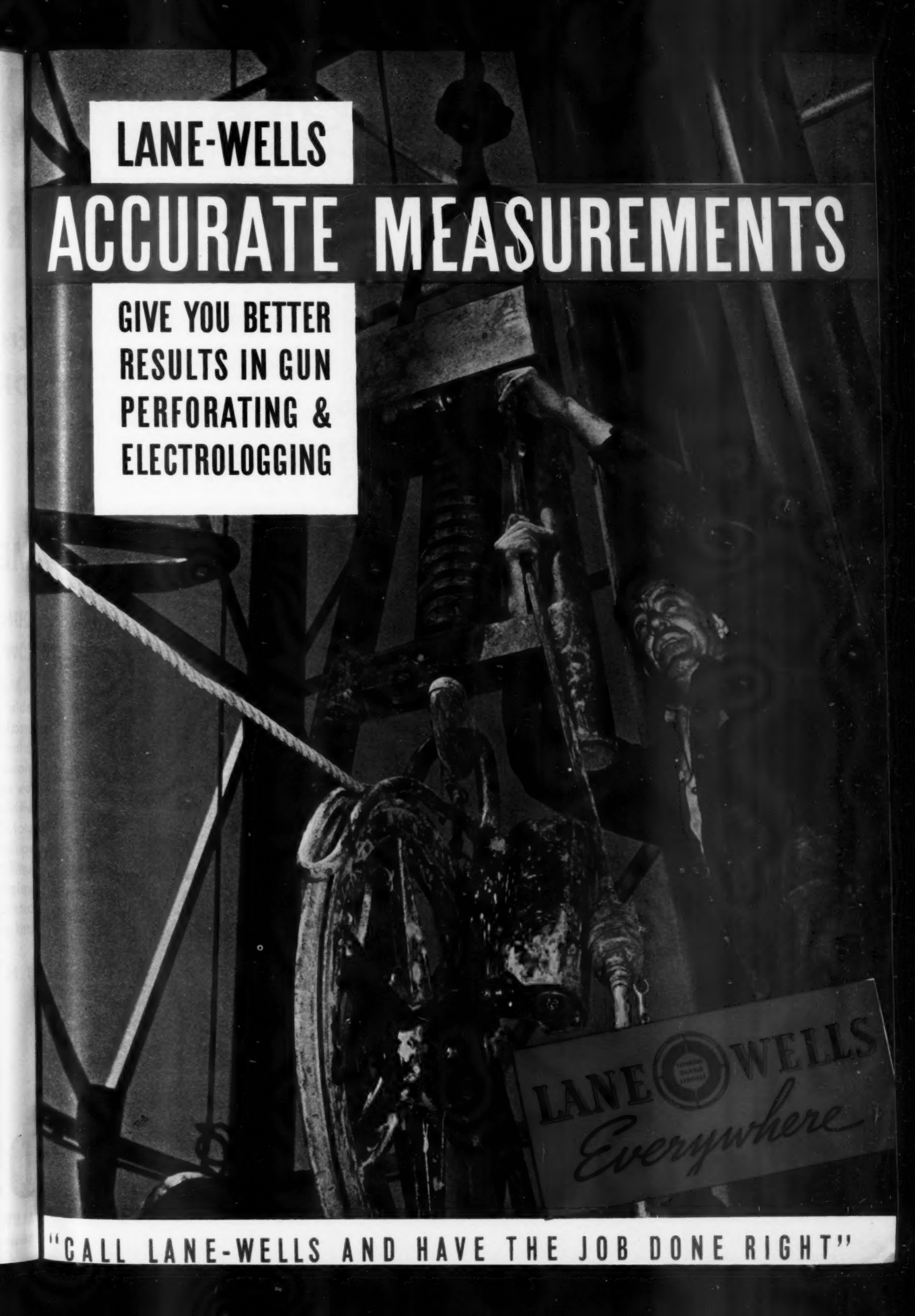
The Lago wells are situated from 1 km. to 7 km. (3280 ft. to 4¼ miles) from shore, but all the Mene Grande wells are within a maximum distance of 1 km. from land. It has therefore been possible for the latter company to construct walkways between the various drilling and producing units and to connect all these units with the shore. Heavy equipment is transported by boats or flat-decked steel barkes.

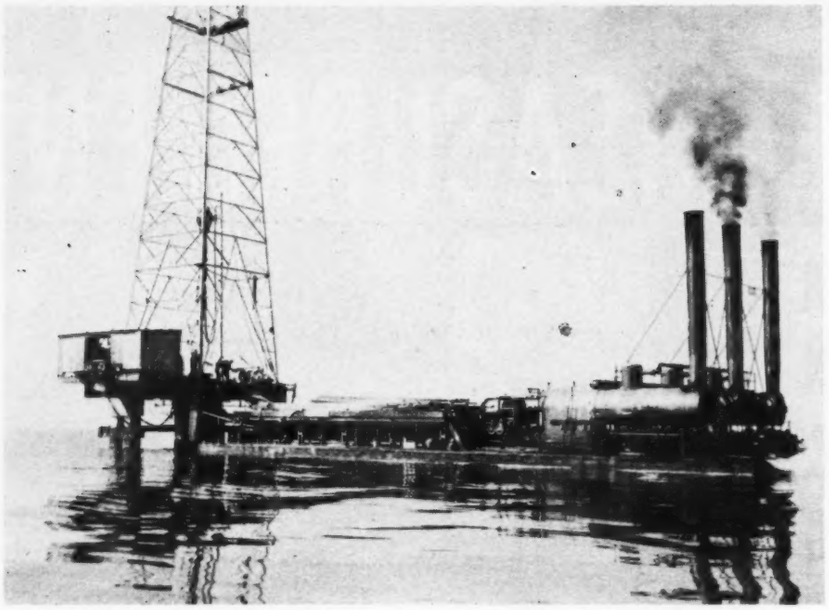
Boiler plants for the Mene Grande operations are usually erected on pile foundations and each battery is so situated as to serve a number of wells. At each well such facilities as pipe rack and mud ditch as well as derrick and rig are supported on pile foundations. Cementing jobs are done from a barge, however, which carries the pumps, cement, and other necessary equipment.

The Lago operations with wells distant more than a kilometer from shore and in water that ranges from a few ft. to 60 ft. in depth obviously require special drilling and production methods. Reinforced concrete piles are used, but as all structures erected are of a permanent nature and are carefully designed to meet the requirements of each unit, the amount of piling has been reduced to a minimum and all temporary piling eliminated. The reinforced concrete piles are precast in a plant at La Salina.

Drilling of each of the Lago wells on Lake Maracaibo is done by means of a barge, which is moved up to the pile-supported derrick and anchored with its forward end parallel to the side of the derrick floor. All drilling is done by steam. On the barge are the boilers, mud pumps, and mud ditch. The deck of the barge provides the pipe rack. All rig equipment is, of course, on the derrick floor, which is connected to the barge by a ramp.

[1]Figures given for 1938 and to the end of 1938 are taken from A.I.M.E. *Petroleum Development and Technology*, 1939, when not supplied by oil companies.


LANE-WELLS
ACCURATE MEASUREMENTS
GIVE YOU BETTER RESULTS IN GUN PERFORATING & ELECTROLOGGING
LANE WELLS
Everywhere
"CALL LANE-WELLS AND HAVE THE JOB DONE RIGHT"



A drilling operation in Lake Maracaibo

Steam and mud are carried between the rig and the barge by hoses.

Cementing is done from a cement barge and the mud supply is maintained by a barge on which tanks are permanently erected.

After the wells on the lake are completed, the oil is piped to a flow station built on piles at a location convenient for handling the production from a number of wells.

A refinery at La Salina, whose capacity is 7000 bbl. daily, tops crude from La Rosa and Lagunillas and one at La Arriega near the city of Maracaibo, having a capacity of 2400 bbl. daily, tops crude from the Lake fields.

Electric power is used for all operations on the Lake after the wells are drilled. This requires a complete transmission system over the entire producing area on the Lake. Structural steel towers carry the main power lines from which service lines branch-off to supply power for pumping wells, flow stations, compressor stations, and absorption plants. Transformers are placed at points where the power is to be used and the current stepped down to the voltage necessary to service the equipment.

The generating plant supplying the current for the Lake operations is situated at Punta Gorda near the boundary between the La Rosa and Punta Benitez fields.

All gas produced by the Lago Lake wells is utilized. Most of the gas is first passed through one of the absorption plants situated on the Lake and the residue then used for fuel or other operations. That in excess of the amount required for fuel and plant operation on both land and water, for camp operations on shore, and for gas-lift, is used for repressuring. Most repressuring is now being done in the La Rosa and Punta Benitez fields and none was done in Lagunillas until within the last year. Until May, 1939, however, 31,143,000 cu. ft. had been injected into Lagunillas wells and 1,151,818,000 cu. ft., in Ambrosio wells.

The Fields of Western Venezuela

Subsurface conditions encountered in the fields present drilling, production, and maintenance problems that are common to all three operating companies. Wells cease flowing and have to go on gas-lift or the pump. Plug-backs and recompletions have to be made and in most cases the purpose of these workover jobs has been the abandonment of lower sands for more economic production in upper zones.

Conversion to gas-lift or to pumping is done when it becomes necessary, but in many of the older areas some wells have to be put on the pump as soon as completed. Other wells are produced by gas-lift as soon as completed.

La Rosa Area

The La Rosa area of the northern Lake fields includes the fields of Ambrosio, La Rosa, and Punta Benitez.

The depths at which the sands are found increase consistently from north to south along the Lake, and the Santa Barbara at Punta Benitez is somewhat deeper than at Ambrosio. The oil zones being faulted throughout there is, of course, a lack of uniformity in the fields. Drilling records for three wells in the Punta Benitez field during May, 1939, are shown in Table 1.

During 1938 there were 46 wells completed and 20 wells abandoned. At the end of the year there had been 1213 wells completed.

Tia Juana Field

The Tia Juana field is now being rapidly developed and has become a competitive area The proved acreage of this field has probably been doubled during the last year and the lighter oil areas have been extended into the lake.

During May, 1939, there were three wells drilled on the Lake in the Tia Juana field. The three wells were at fill-in locations and required an average drilling time of only 10.7 days, no coring being necessary on any of them.

During 1938, 171 wells were completed in the Tia Juana field and at the end of the year the field had a total of 439 wells completed. All wells in this field are strictly oil wells, the only gas produced being that accompanying the oil.

It is only during the last year that all storage and terminal facilities have been completely equipped to handle the production from this field. Although the productive acreage has been extended, its area is not much more than half that of the La Rosa area (including Ambrosio and Punta Benitez) and is less than 40 percent of that of Lagunillas. Its production, however, now exceeds that from the La Rosa area but is still less than 70 percent of the production from Lagunillas.

Lagunillas Field

Still the largest producing field in South America, Lagunillas is also an active drilling area. Of considerable interest is the activity at the southern end of the field where the Lagon and Lagote wells were drilled some years ago. Although most of the wells completed in 1938 were fill-ins and continued the development of the field, a number were drilled in this southern extension of the field on both land and water.

There are now six electrical dehydration units treating the oil from

TABLE 1
Wells Drilled in May, 1939—Punta Benitez

Well	*"A"*	*"B"*	*"C"*
Moving-in	0.3	0.5	0.3
Rigging-up	1.2	0.4	0.4
Drilling	3.2	3.9	2.5
Coring	10.1	0.8	—
Reaming	2.8	0.6	0.5
Casing and cementing	11.9	5.3	5.8
Electrical survey	0.9	0.1	0.1
Repairing	—	—	—
Completing and testing	19.7*	1.3	1.9
Dismantling	0.3	0.4	0.3
Other developments	0.3	—	—
Gun-perforating	1.3	—	—
	52.0	13.3	11.8

*Testing 4 horizons.

The World's FASTEST, SAFEST SUREST *Coring Method.....*

and therefore the lowest cost per core!

THE HUNT Retractable Core Barrel represents a decided improvement over conventional methods of recovering cores by wire line. The core cutter is integral with the bit, not the barrel . . . the barrel seating in the bit just above the cutting element, rather than running through the bit. It latches under a sleeve near the top of the drill collar. Thus the barrel itself has no part in cutting the core, but merely receives it, thereby relieving the barrel of cutting strain and permitting a lighter wall . . . and a resulting larger core.

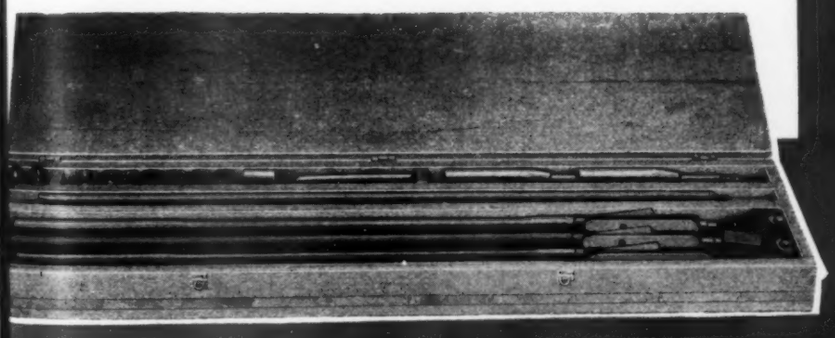
An outstanding advantage of this barrel is the drilling efficiency and speed of the core bit between coring points, it not being necessary to come out of the hole and change from core bit to regular bit between points to be cored.

The Hunt Barrel, proven by seven years of hard service, is now standard coring equipment with more than 20 major companies and many of the industry's well known drilling contractors.

The Hunt Barrel is sold or rented in U. S. fields and sold for export. It is represented on the West Coast by Dunlap Welding & Bit Works, Bakersfield, California.

Soft formation core head, made in 2-way and 3-way types.

Hard formation core head, made in 4-cutter and 6-cutter types.



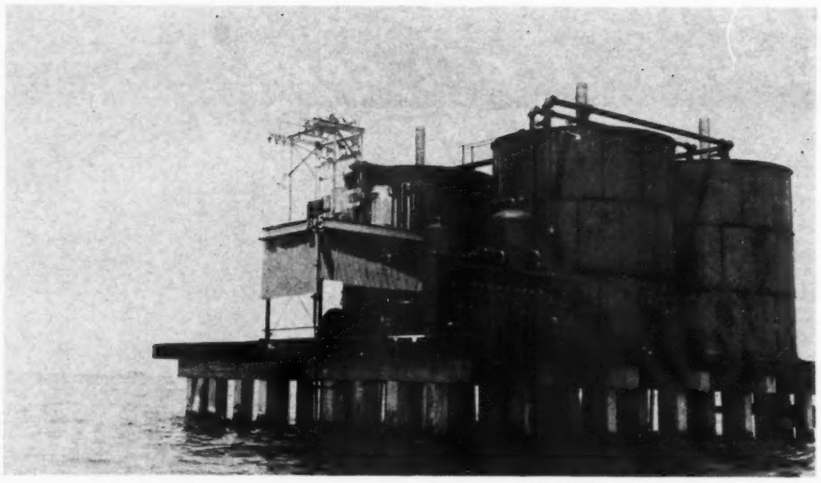
Hunt Core Barrel and parts in packing box, ready for shipment.

Sectional view of Hunt Core Barrel, showing barrel in place for coring.

HUNT TOOL COMPANY

HOUSTON, TEXAS, U. S. A.

HUNT TOOL COMPANY



A flow station, Lake Maracaibo

wells being produced by Lago Petroleum Corporation. The efficacy of dehydration is indicated in the record of the plant operation for April and May, 1939, shown here:

	April, 1939	*May, 1939*
Average water content before treating	6.68 percent	7.17 percent
Average water content after treating	1.06 percent	1.09 percent
Average daily net treated oil at 60°F.	8872 bbl.	9452 bbl.

Subsurface pressure surveys are made at regular intervals; the data resulting are used for production control.

During 1938 there were 97 wells completed and three wells abandoned in the Lagunillas field. To the end of the year 1168 wells had been completed.

Bachaquero Field

Although discovered ten years ago, Bachaquero can probably be classed as a new field as its active development began during the last year. The proved acreage of the field is a little less than that of Tia Juana but the area drilled to date is still rather small.

Only eight wells had been drilled in this field from the time of its discovery until the present activity began. These were put down mainly to determine production possibilities. During 1938, 26 wells were completed. Nearly all the million bbl. of oil produced from the field to the end of the year was produced in 1938. Gathering and terminal facilities have been completed by only the Venezuelan Oil Concessions, Ltd., and most of the development thus far has been on shore concessions.

Mene Grande Field

Drilling activity increased in the Mene Grande field last year despite the fact that it is the oldest field in Venezuela. The field is operated by the Caribbean Petroleum Company, a Shell subsidiary, and oil is piped from the field to San Loranzo on Lake Maracaibo. A portion of the oil is refined in the company's plant there; the rest is shipped from the San Loranzo port.

Production comes from two zones, the upper of which is younger Tertiary, and the lower, the Misoa Trujillo of the Eocene.

There were 51 wells drilled in this field during 1938; at the end of the year the field had a total of 367 wells completed. Only 120 wells were producing oil at the end of 1938; of these, 14 produced oil and gas, 213 wells being temporarily shut-in. Of the producing wells, 51 were flowing, 25 were on gas-lift, and 58 were pumping.

Although more wells were drilled in 1938, the production for that year declined to 12,506,000 bbl. from 14,410,000 in 1937, a decline of 13 percent.

Cumarebo Field

The Cumarebo field, producing the lightest oil in Venezuela, provides an outstanding example of the benefits that can be obtained by the return of gas to a reservoir when conditions are favorable. Production comes from three sands in the Damsite zone and from seven sands in the Socorro zone below.

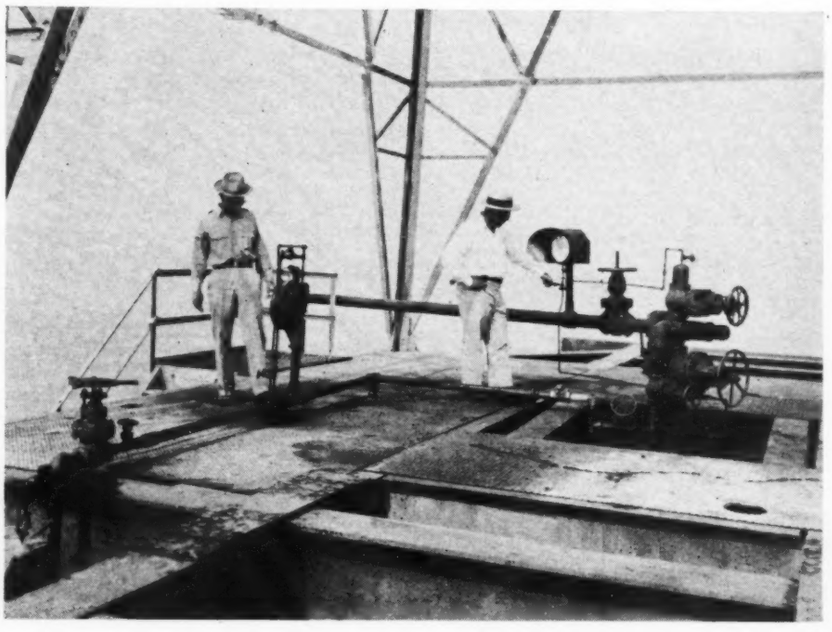
During 1938, eight new producers were completed in the field. Production from these wells and the stimulus of gas returned to the producing zones offset the decline of the field.

The average daily production from Cumarebo during 1938 was about 7000 bbl. Of 112 wells drilled in the field, 75 are now producers.

The gas produced in the field is utilized to the best advantage possible. Data for 1938 are summarized as follows:

Gas produced	*M. cu. ft.*
Daily average	3,957
Total for 1938	1,444,290
Total to date	11,926,600
Gas returned to formation	*M. cu. ft.*
Daily average	2,525
Total for 1938	921,710
Total to date	5,231,553

Four general surveys of subsurface pressure were made at Cumarebo during 1938 and closed-in pressures were obtained every three months and the data obtained are used for production control.



Gas-lift well, showing connections and steel flooring

Still the DEPENDABLE Method of Well Completion!

THE LAYNE

Wherever oil flows, Layne products are known to do their job successfully, efficiently and economically. These proven products are the result of more than a third-century of close co-operation between designing engineer, construction craftsmen and field superintendents. They embody every feature necessary to assure simplicity in use . . . durability in service and economy in purchase. You can depend on Layne products to give maximum service per dollar invested.

LAYNE & BOWLER CO.

HOUSTON, TEXAS

Export--Room 1636 30 Rockefeller Plaza
New York, N. Y.

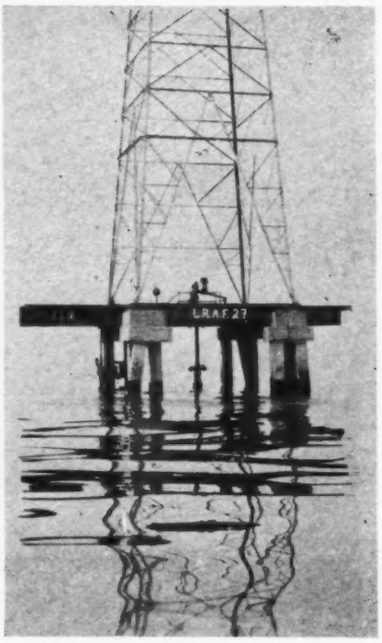
Other Active Fields

El Mene Field. Approximately 30 miles east of the northern entrance to the lake at Altagracia, situated opposite the city of Maracaibo, is the El Mene field, the most westerly of the four producing areas of El Mene, Media, Hombre Pintado, and Las Palmas. All these are light-oil fields and are operated by the British Controlled Oilfields, Ltd.

Production in El Mene field is obtained from the Agua Clara sand of the Oligocene and well depths average 1020 ft. The gravity of the oil ranges from 35 to 43 deg. A.P.I. There were 210 completed wells at the beginning of this year. Of 80 producing wells, half were pumping and half on gas-lift at the end of 1938, and 79 other wells were temporarily shut-down. Oil is piped to Altagracia through a 6-in. line.

Media Field. Production in the Media field also comes from the Agua Clara but well depths average 3270 ft. The average gravity of the oil is 39 deg. A.P.I. There had been 20 wells completed to the end of 1938; of these 12 were shut-in, six were producing oil, and two were gas wells. Oil is shipped through a pipe line from the Hombre Pintado field.

Hombre Pintado Field. This field, also producing from the Agua Clara, saw a little drilling activity during 1938. Wells average slightly more than 2000 ft. in depth, but the gravity of the oil is only 19 to 29 deg. A.P.I. Seven wells were drilled during 1938; at the end of the year, six wells were shut-in, five of which are oil wells and one gas. Oil from the field is piped to Altagracia through a 4-in. line that goes to the El Mene field and from there parallels the 6-in. line from that field.



Flowing well, showing latest type concrete pile foundation

Las Palmas Field. After being shut-down for eight years, this field was put on production in 1938. This production comes from a sand known as Patiecitos in the Oligocene, well depths averaging 2550 ft. Although seven wells had been completed to the end of 1938, only one well was then producing and two were shut-in. No wells were drilled during the last year. The oil is piped to the Hombre Pintado field and from there to Altagracia.

La Concepcion Field. About 17 miles west of Maracaibo is the La Concepcion field. This field is operated by the Caribbean Petroleum Company and produces from sands and shales in the Eocene at depths averaging 2000 ft. The gravity of the oil is 37 to 38 deg. A.P.I. It is piped through a 6-in. line to a point on Lake Maracaibo. At the end of 1938, 36 wells were shut-in and 65 were producing oil, two of the latter flowing and the rest on the pump.

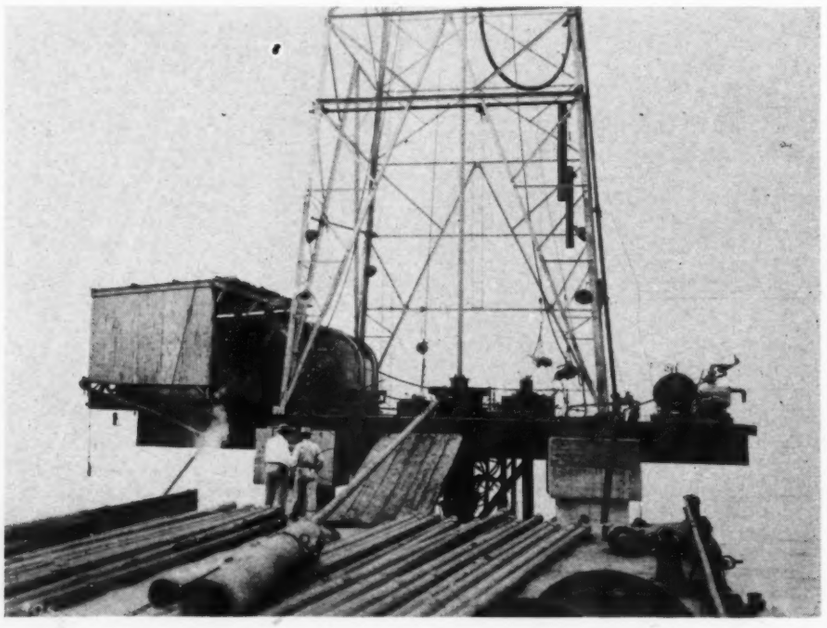
La Paz Field. This field is 12 miles farther west than La Concepcion and the oil from it is piped through an extension of the line between La Concepcion and the Lake. Production is obtained from what is called the La Paz series in the Eocene, the depths of wells averaging 2000 ft. All 23 of the producing wells are on the pump.

Los Manueles Field. Approximately 65 miles southwest of Lake Maracaibo and lying in the Colon District are three producing structures on a long anticline known as the Tarra Anticline. All operations along this anticline are those of the Colon Development Company, Ltd., a Shell subsidiary. The most northerly of these fields is Los Manueles. Production comes from the Eocene, well depths averaging 4000 ft. and greater. The oil ranges in gravity from 30 to 35 deg. A.P.I. Three new wells were completed in 1938, bringing the total completed in the field to 19 by the end of the year, at which time 11 wells were pumping and 5 were shut-in. Production was 1,343,000 bbl. during the year—a slight increase over that of 1937.

A 9-mile, 8-in. pipe line extends from Casiqua, situated at the north end of the Rio Tarra field, passes through Los Manueles, and terminates at Coloncha, the terminal on the Lake from which oil from the Colon District fields is shipped.

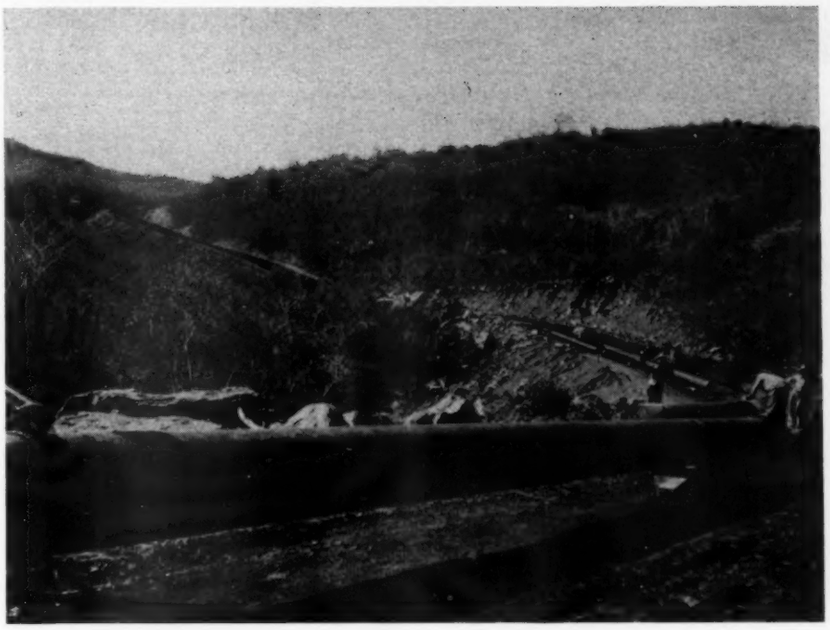
Rio Tarra Field. This field actually consists of two producing areas, El Cubo to the north and Las Cruces to the south, both on the Tarra Anticline. Production is from the Eocene but at Las Cruces the oil comes from one zone in the overthrust of a fault and from three in the underthrust, wells in the overthrust zone being drilled as shallow as 700 ft. and in the lower sand of the underthrust zone as deep as 5000 ft.

During 1938, nine wells were completed in the Rio Tarra field and to the end of that year, a total of 90 wells had been completed. The oil is transported to the terminal on the Lake by a line passing through Los Manueles field.



Drilling rig having a caisson foundation

P 615.3
P 122.



Welding the line over the Sierra Grande mountain

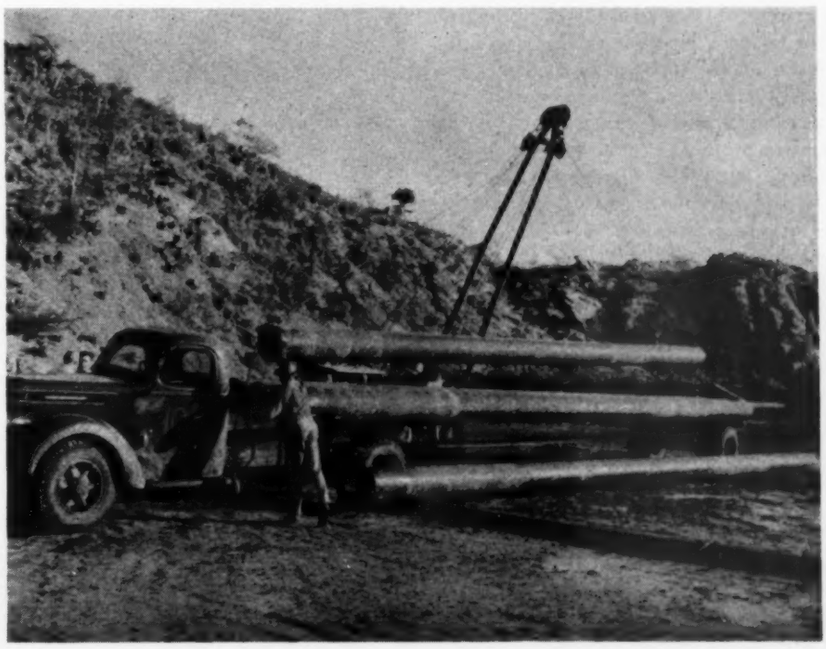
By
FRANK H. LOVE
Managing Editor

World's Longest 16-inch Oil Pipe Line Laid in Eastern Venezuela

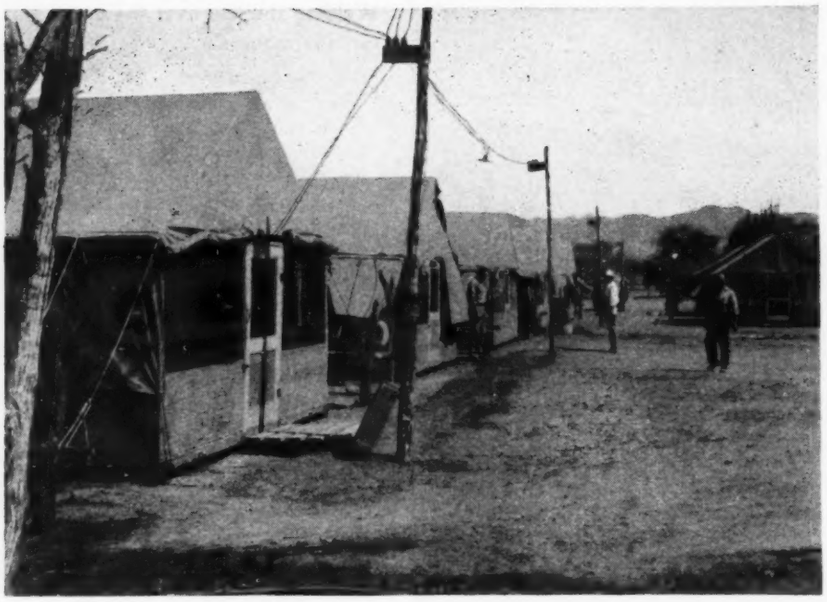
Line constructed by Mene Grande Oil Company from Guanta to the Oficina field, a distance of 97 miles, will provide a needed outlet for crude oil

THE Mene Grande Oil Company recently completed construction of the longest 16-in. diameter pipe line ever laid for the transportation of crude oil. The line extends from Guanta in Eastern Venezuela 156½ kilometers (97 miles) in a southerly direction to the Oficina field. At Guanta a deep-water loading terminal is being built and 11 kilometers (6.8 miles) from the Oficina field the only pumping station on the line is being erected. The delivery of oil a distance of 97 miles with but a single pump station is made possible by the fact that the Oficina field, origin of the crude oil, is 1000 ft. above sea level and the terminal at Guanta is at sea level. Consequently, limited initial pumping is required, the flow being almost entirely by gravity.

If laid during the rainy season of the year, that is, in the fall and winter, the laying of this line would have been replete with difficulties. The contractors, however, avoided these difficulties by choosing the dry season in which to perform the work. As a preliminary step, also, and to facilitate



Loading the 16-in. pipe onto a truck for stringing



A street of the camp at Guanta

the actual construction work, a road was first built along the pipe-line right-of-way. This road was oiled and later will be graveled. It will serve a twofold purpose. In the construction of the line it was of invaluable service, facilitating the stringing and the laying of the pipe. The line completed, it will be used by the operating and maintenance personnel in facilitating their operations.

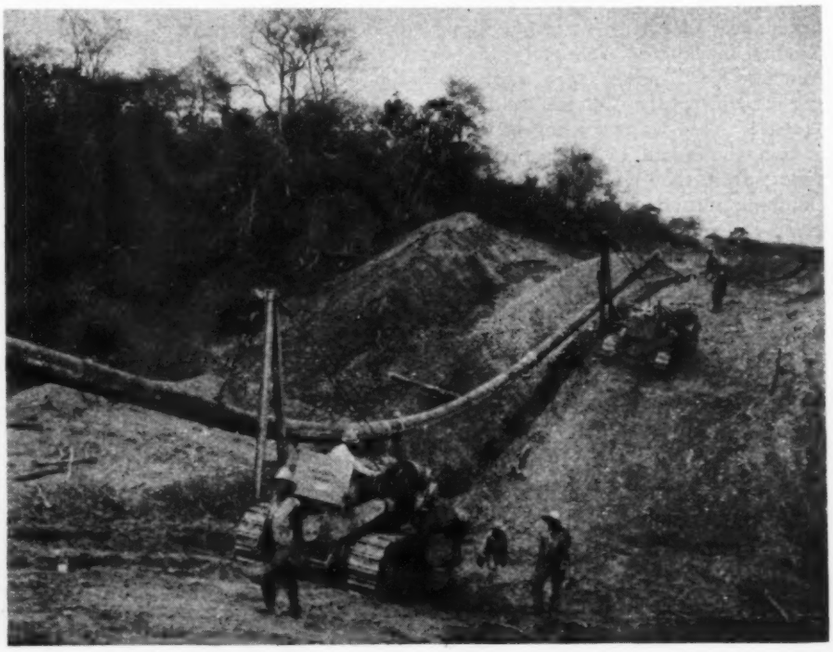
Aside from the fact that several mountain ranges were crossed, which necessitated the making of more than the usual number of bends, construction procedure was much the same as that employed in the States.

To those not familiar with the topography of Venezuela or the problems of laying a pipe line in the area, a review of the topography of Venezuela and the procedure followed during the various stages of construction should prove of interest. The first mountain range, the Pele el Ojo, was entered 12 kilometers (7.5 miles) from the Guanta terminal. The elevation of this range is 350 ft. and the distance through it is 5 kilometers (3.1 miles). The Neveri River was reached 2½ kilometers (1.6 miles) after the line emerged from the mountain range. From bank to bank this crossing was 120 ft. At the time the line was laid the river was shallow and a dragline was used to dig the pipe-line ditch. The river during the rainy season, however, becomes deep and is extremely swift. The pipe was given a 36-in. covering at this point.

On the northern end of the line, mountain ranges and river crossings succeed each other in rapid succession. Only one kilometer from the point on the Neveri River where the crossing was made, the Cerro Grande Mountains were entered and because of the multiplicity of its peaks the number of side bends required to avoid them were many. The distance through these mountains, which have an elevation of 465 ft., was 6 kilometers (3.7 miles). The Rio Capiricual Valley was next traversed, for a distance of 5 kilometers (3.1 miles), followed by the Bocadel Tigre Mountain. Although this mountain is of low elevation, the road through it is as nearly vertical as is possible while still permitting its use by motor truck. A sudden shower frequently would make the road too slick for use in a few moments' time. This condition usually lasted not more than half an hour, however; consequently it was not an important factor to consider in the total time required to lay the line. It does serve to illustrate, however, what might have happened had not the proper time of the year been chosen in which to construct the line. This road is now being graveled to obviate the operating men being faced with an insurmountable condition in fall and winter months when the rains are heavy.

The Bocadel Tigre swamp succeeded the mountain that bears the same name and for a distance of 2½ kilometers (1.6 miles), a dragline was used to make the ditch. All equipment was operated from the roadway. The line pipe was roll-welded in sections consisting of 10 to 15 joints, averaging 40 ft. to the joint. Because of the roughness of the country, ordinarily sections consisted of 3 to 7 joints of pipe. The Querecual River traversing this swamp was crossed by the pipe line. The river is narrow, however, being little more than a creek.

The 14 kilometers (8.7 miles) from



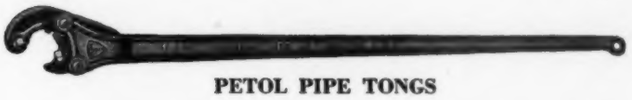
Lowering long sections of pipe near Cantaura

PETOL & TITAN TONGS

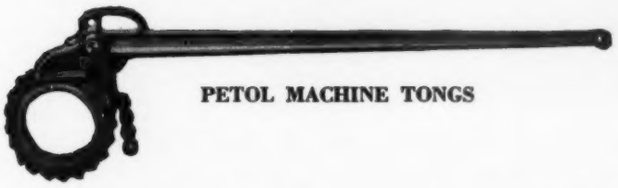
"Most Complete Line of Tongs in the World"

New Catalog 40, just off the press, fully describes these and other PETOL and TITAN Tools.

PETOL STABBING TONGS

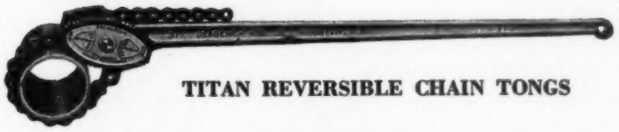


PETOL PIPE TONGS



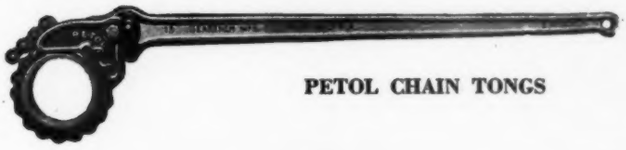
PETOL MACHINE TONGS

TITAN CHAIN TONGS



TITAN REVERSIBLE CHAIN TONGS

TITAN PIPE TONGS



PETOL CHAIN TONGS

PETOL TUBING TONGS

PETOL TOOLS TITAN TOOLS

25 TYPES

275 SIZES

GEARENCH MFG. COMPANY

HOUSTON, TEXAS, U.S.A.

EXPORT OFFICE: 74 TRINITY PLACE, NEW YORK, N. Y.

David R. Williams of Williams Brothers Corporation

the Bocadel Tigre swamp to the Aragua River was through rolling country. The Aragua crossing required 120 ft. of pipe. The next 14 kilometers was through bottom land, level for the most part, but interspersed by several small hills. At the end of this stretch is San Mateo, one of the few towns along the route of the pipe line. For a distance of 31 kilometers (19.3 miles) after leaving San Mateo, or until the Anaco River was reached, the line passed through territory comparable to one of the "dust bowl" areas in the United States. The terrain was level, however, and permitted fast construction time. The Anaco River crossing was only 100 ft. in width. For 14½ kilometers (9 miles), until the Carpintero River is reached, the country is of a rolling nature dotted by a few clay hills. This river was dry at the time the line was laid, its bed being 50 ft. in width. Another 50-ft. dry river, the Guario, was crossed 1½ kilometers (0.9 miles) farther on. At a distance of 11 kilometers (6.8 miles) from this river the line passes within one-half mile of the town of Cantaura, where one of the two camps was maintained for the workmen. From this point to the end of the line, a distance of 35½ kilometers (22 miles), the country was level and conditions generally were ideal for pipe-line work. On this 35½-kilometer section, a 100-ft. crossing was made of the Guanipa River.

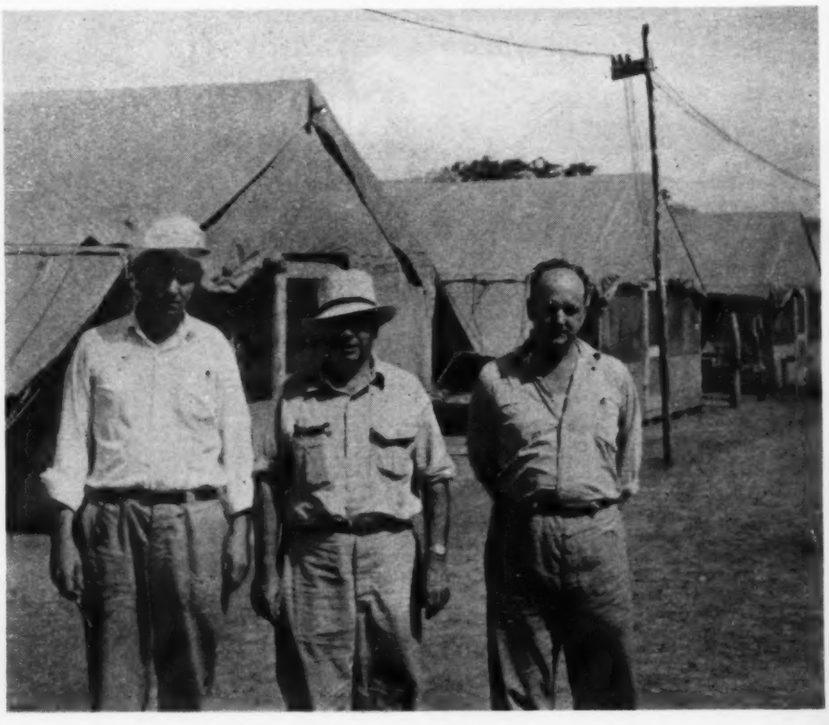
The line was constructed of 451,000 linear ft. of 16-in. A.P.I. seamless Standard Grade B pipe having a ⅜-in. wall thickness, and 70,000 ft. of A.P.I. Standard Grade B pipe having a 0.40625-in. wall thicknesss. The pipe was supplied in 40-ft. joints. Delivery was made to the terminal at Guanta and the pipe strung from trucks along a pipe-line right-of-way 50 meters (164 ft.) in width.

The line was coated by enamel over its entire length and all but 44½ kilometers (27.7 miles) was wrapped with asbestos felt. Through sandy soil where corrosion is not considered a serious factor the pipe was not wrapped. Specifications required that a flood coat of enamel be applied at a temperature of 400°F. This was done after the pipe had been cleaned and primed. For the work, the new type machines that apply the coating and wrapper in one operation were used.

Testing of the line was in mile sections, 100-lb. air pressure being applied after the welds had been soaped. The completed line was given a water test at 800-lb. pressure.

All welding was by the roll-weld method using the electric arc. Pipe ends were plain and the welds were made without back-up rings. Only one firing-line gang was employed, although an extra tie-in gang was added before the job was finished. It was necessary to send welders, foremen, truck drivers, mechanics, superintendents, etc., from the United States. For the unskilled work, Venezuelan labor was employed. The firing-line gang consisted of a tacker and five to six welders. To make the tie-ins two welders worked together, tacking and running the first bead. Others followed to make the finish beads. Welding machines used for tacking were mounted on trucks, those used by the firing-line gang were mounted on wagons and drawn by tractors. For making the firing-line welds, 400-amp. units were employed; for tying-in, 200- and 300-amp. units. To make roll welds, $\frac{3}{16}$-in., ¼-in., and $\frac{5}{16}$-in. electrodes were used, and for tie-in welds, $\frac{5}{32}$-in. and $\frac{3}{16}$-in. electrodes.

Williams Brothers Corporation-S. D. Bechtel Company were the general contractors for the line. H. C. Price Company, Bartlesville, Oklahoma, was the welding contractor.



Left to right: A. L. Broadway, welding superintendent; H. C. Price, president, and A. T. Beaman, office manager, H. C. Price Company

IDECO

HAS THE FACILITIES

MAIN OFFICE, COLUMBUS, OHIO

IDECO FACTORY, COLUMBUS, OHIO

ROOTS-CONNERSVILLE BLOWER CORPORATION
CONNERSVILLE, INDIANA

IDECO FACTORY, BEAUMONT, TEXAS

IDECO FACTORY, TORRANCE, CALIFORNIA

IDECO FACTORY, DELAWARE, OHIO

IDECO FACTORY, MARIETTA, OHIO

STRUCTURAL SHOP, COLUMBUS, OHIO

MACHINE SHOP, CONNERSVILLE, INDIANA

PUMPING UNIT ASSEMBLY SHOP, COLUMBUS, OHIO

FABRICATING SHOP, STACEY BROTHERS GAS CONSTRUCTION COMPANY, CINCINNATI, OHIO

—PLANT CAPACITY—PLANT LOCATIONS—WITH CONVENIENT SALES OFFICES AND BRANCHES IN ALL ACTIVE OIL FIELDS.

The design, construction and application of IDECO products are each based upon the knowledge of every desirable and practical feature known to oil country experience as well as the experience gained in manufacturing heavy machinery for more than eighty years.

IDECO is a reliable organization of financial, engineering, manufacturing, selling and distributing units, operating under centralized management and devoted to the production of Oil Country Equipment—

Oil Well Production Equipment
Geared Pumping Units
Production Derricks
Rotary Drilling Equipment
Cable Tool Drilling Equipment
Rigs and Jacks
Standard Steel Buildings
Special Steel Towers
Stacey Telescopic Gas Holders
Stacey-Klonne Gas Holders
Stacey "Bullet" Gas Storage
Stacey Purifiers
Rotary Blowers and Gas Pumps
Centrifugal Blowers and Gas Pumps
Rotary Vacuum and Liquid Pumps
Turbine Pumps
Rotary Displacement Meters
Inert Gas Producers

—all engineered and produced through the facilities of the IDECO organization.

THE INTERNATIONAL DERRICK & EQUIPMENT CO.
DIVISION OF INTERNATIONAL-STACEY CORPORATION
Beaumont, Texas — Columbus, Ohio — Los Angeles, Cal.

PLANTS

IDECO, Columbus, Ohio IDECO, Marietta, Ohio
IDECO, Delaware, Ohio IDECO, Beaumont, Texas
IDECO, Torrance, Cal.
Stacey Brothers Gas Construction Co., Cincinnati
Roots-Connersville Blower Corp.
Connersville, Ind. and Pottstown, Pa.

DIVISION SALES OFFICES

New York, San Francisco, Chicago
Beaumont, Los Angeles, Detroit
St. Louis, Pittsburgh, Wichita
Columbus, Cincinnati, Houston
Kilgore, Tulsa, Dallas, Boston
Buenos Aires

YEARS OF EXPERIENCE IDECO THE WORLD OVER

There is no substitute for Oil Country Experience in Building Oil Country Equipment

IDECO

One-family houses for skilled laborers

By
WALLACE A. SAWDON
Pacific Coast and Foreign Editor

Excellent Living Conditions Provided Employees in Venezuela

Health, education, and pleasant surroundings for workmen are paramount considerations to oil companies operating in the tropics, who find the undertaking a most profitable one

REALIZING that health, education, and pleasant working conditions are necessary for the progress of a people and for maintaining productive working ability, the oil companies operating in Venezuela have made a thorough study of local requirements and have expended large sums of money in providing proper facilities for their employees. This was true before any regulatory measures were set up by the government; and minimum requirements that have since been established have been exceeded to a considerable extent.

Both Venezuelan and foreign workmen profit by the facilities provided by the oil companies. The labor law requires that not less than 75 percent of all employees be nationals but the number working for the various companies exceeds this percentage. Of the total of approximately 6000 men employed by Lago Petroleum Corporation and Standard Oil Company of Venezuela, for example, 5580 are Venezuelans and 420 are foreigners. The number of nationals is thus about 93 percent. The salaries of these men amount to approximately Bs. 75,000 ($24,500) daily or Bs. 2,250,000 ($735,100) monthly. This money remains in the country and contributes to a considerable extent toward bettering the standard of living of the people.

The housing of all these men and their families is no small undertaking in itself and the same problem confronts all the oil companies. The social services of the companies, however, include much more than the mere housing of employees. Medical care and hospital facilities are made available, schools offer instruction to both children and adults, recreational centers are provided at the various camps, commissaries supply food at reasonable cost, churches and other public buildings have been erected, and roads have been made usable for general transportation purposes although they were built for the purpose of serving the oil industry. Each camp requires proper sanitation and utility services that necessitate the construction and maintenance of sewers, gas and water lines, and electric transmission systems.

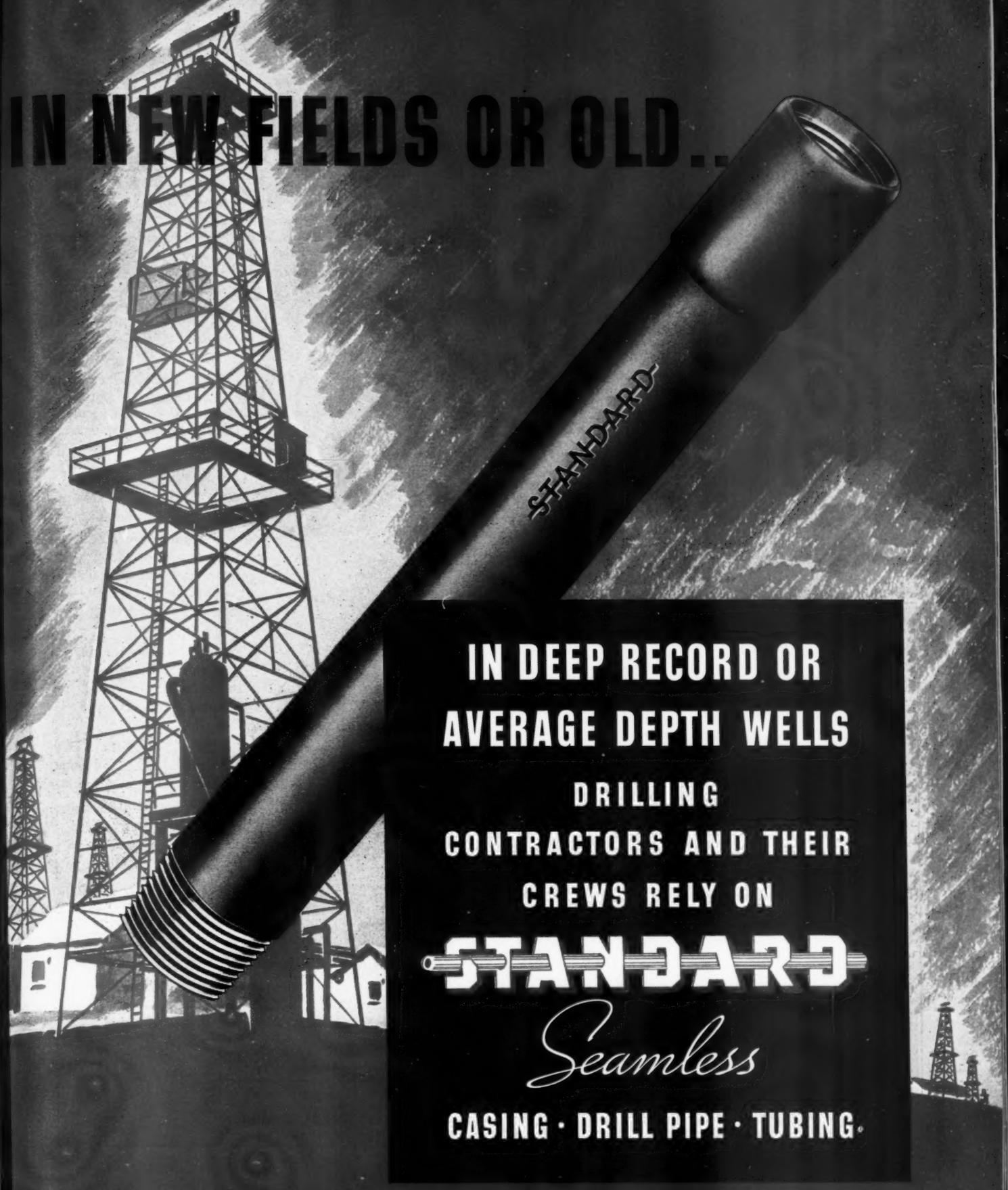
The magnitude of the work of caring for the well-being of employees is evident when the number of activities and the size of some of the camps are considered. Although the greatest facilities are provided at and around the established fields and refineries, living conditions at wildcat locations often far removed from sources of supply are also maintained of comparable standard. Permanent structures are, of course, not built until a discovery is made, but the health and living conditions are carefully provided for during the entire time an isolated camp is being used.

Citing the two largest operating groups in Venezuela, the extent and cost of housing and social service work throughout the entire country can be gauged. The first is the Standard group that consists of the affiliated companies, Lago Petroleum Corporation and Standard Oil Company of Venezuela. The other is the Shell group comprised of Venezuelan Oil Concessions, Ltd., Caribbean Petroleum Company, and Colon Development Company, Ltd.

Standard Oil Companies

Housing. The average area provided per person is approximately 7.5 sq. meters (80.7 sq. ft.), which is considerably in excess of the 4.5 sq. meters (48.4 sq. ft.) designated by law as the minimum. All the houses for the sheltering of employees are constructed on a permanent basis, including concrete foundations and all modern sanitary facilities. In general, four types of dwellings have been built to accommodate the various classes of workers.

IN NEW FIELDS OR OLD..



IN DEEP RECORD OR
AVERAGE DEPTH WELLS
DRILLING
CONTRACTORS AND THEIR
CREWS RELY ON

STANDARD
Seamless
CASING · DRILL PIPE · TUBING

SPANG CHALFANT, INC.

GENERAL OFFICES: Grant Building, Pittsburgh, Pa.

Sales Offices:

BOSTON NEW YORK PHILADELPHIA PITTSBURGH
ATLANTA CHICAGO ST. LOUIS TULSA HOUSTON
SAN FRANCISCO LOS ANGELES

A typical house in Caripito for white collar employees

The above includes the work done to January 1, 1939. During 1939, there are estimated expenditures of Bs. 1,000,000 ($326,700) for a hospital at Caripito and Bs. 1,654,909 ($540,700) for eight other hospitals and dispensaries requiring the services of 13 additional medical doctors. In addition there is the Lago's participation in the Shell hospitals at Maracaibo and Lagunillas. Other expenditures to be made during 1939 have not been estimated but include new houses being built at Temblador.

Aside from the other phases mentioned, which directly concern the life of the workmen, it should also be mentioned that the companies have built more than 100 kilometers (62 miles) of roads. Despite the fact that these roads are principally destined to aid in the industrial development, they are also open to the public and many of the agricultural areas take advantage of these modern and ample facilities. More than Bs. 5,600,000 ($1,830,000) has been spent in roads, bridges, and similar works, all of which indicates a considerable collective betterment.

Shell Companies

The following summary of the program of construction and social facilities undertaken by the Shell companies in Venezuela for the benefit of their workmen covers the years 1936 to 1939, inclusive. For the remaining months of 1939, from the date this report was made, the program has been conservatively estimated and is ahead of schedule.

Housing. Four types of houses are provided, differing according to the class of employee. One type, having an interior area of 53.06 sq. meters, is for married office employees, each house accommodating one family; another type, also one per family, accommodating married skilled laborers, has an interior area of 35.81 sq. meters. Married skilled laborers are also housed in cottages, each of which shelters two families, providing a total interior area of 42.86 sq. meters per family. Another style of house accommodates three families, and provides each family with an interior area of 40.53 sq. meters.

All houses have raised concrete foundations, brick walls on the interior side of which a smooth finish of cement and lime is applied, and roof and ceilings of wood covered by asbestos. Windows and doors are fitted with wire gauze. Modern sanitary cooking and washing facilities are provided in each house. Gas, water, and electricity are provided in each house, and connections are made to main ventilated sewer lines. The following table shows the status of the housing program as at the end of 1939:

Type	*No. of Houses*	*Accommodation No. of Families*
One-family houses for skilled laborers	296	296
Two-family houses for skilled laborers	122	244
Three-apartment houses	1003	3009
One-family houses for staff members	301	301
Other houses	21	39
Total	1743	3889

Hospitals. In each of the five fields, the companies have a well-equipped dispensary. In addition, in Lagunillas, a modern hospital, attended by a highly-trained personnel, is maintained.

In Maracaibo, the Caribbean Petroleum Company has established a large modern hospital to provide medical care for the employees of the Lago and British Controlled Oilfields, besides those of the Shell companies mentioned. This hospital measures 130 by 100 meters, and is divided into two wings separated by a large patio. Its 80 rooms provide accommodation to 240 patients; in addition, three large rooms will accommodate approximately 90 patients.

Included in the special departments of the hospital are: surgery, laboratory, autopsy room, isolation ward, massage room, electrotherapy chamber, special rooms for maternity cases, nurseries, operating chamber, etc. The hospital is equipped with modern electric kitchens, and has its own power plant and workshops.

A large and highly-trained staff of doctors and nurses attends the patients, giving the same care and attention to all, regardless of class or nationality. The hospital is the only one of its kind in Venezuela.

Restaurants. Thirteen restaurants are situated in the various camps and headquarters of the companies, and meals are provided therein at economical prices.

Other Facilities. In addition, the companies have provided the following facilities for the benefit and recreation of their employees:

Sports fields, complete with grandstands, etc.	4
Schools	6
Clubs	2
General markets	3
Meat markets	3
Incinerators	6
Slaughter house	1

Expenditures. The amount of money spent by the Shell companies for housing and other facilities in Venezuela to the end of 1939 will be approximately Bs. 23,876,050 ($7,800,300). This includes, besides the cost of the buildings, the cost of laying water, gas, sewer systems, and other facilities.

for- Maximum Performance -at Minimum Expense

EQUIP YOUR ENGINES AND COMPRESSORS

TYPICAL "PERFORMANCE" USERS OF COOK'S PRODUCTS

with

Cook's *Graphitic Iron* Piston Rings

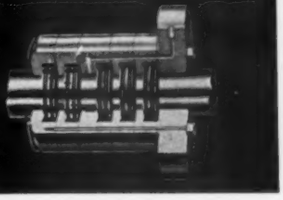
and

Cook's Metallic Packings

Designing and operating engineers find in COOK'S Graphitic Iron Piston Rings and Metallic Rod Packings those qualities which enable gas-driven compressors to give ***maximum performance at minimum expense.*** These rings and packings—vital parts of any engine or compressor—have played a great role in making the equipment manufactured by leading companies more efficient and dependable. That's why over 90% of the gas engine driven compressors built in recent years were equipped with COOK'S products. You, too, can obtain maximum performance at minimum expense. ***Consult the COOK representative in your territory, or write us direct for full details.***

C. LEE COOK MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.

New York · Cleveland · Los Angeles · Baltimore · Chicago · Tulsa · New Orleans · San Francisco



Duplexes for skilled workmen staff members

Two of these types are individual houses for technical employees and supervisory staff members; houses of the third type have two apartments (duplex) and are for skilled workmen and supervisors; and those of the fourth type, for three, four, or six families, are intended for the rest of the workmen. The following tabulation shows the considerable number of dwellings constructed, including those intended for families and bachelors, and the large sum of money invested for that purpose.

Class	Number	Cost	
		Bolivars	Dollars
One-family houses	116	3,050,454	996,600
Duplex houses (two families)	503	4,422,160	1,444,700
Houses for more than two families	250	3,622,595	1,183,500
Total number of families accommodated in dwellings (viviendas)	2,267	11,095,209	3,624,800

Schools. The schools that have been built and are now in use serve as an example of the most modern and complete in their line, the company having constructed five schools at the cost of Bs. 391,262 ($127,800). At present, approximately 2000 children attend these schools.

Clubs, Stadiums, and Recreational Facilities. Special consideration has been given to the social life and entertainment, these being under the direct supervision of competent personnel. The company has constructed, organized, and equipped ten clubs and sports grounds at a total cost of Bs. 571,480 ($186,700) and, consequently, the workers find life in the camps even more interesting and comfortable in many respects than in the cities.

Markets and Commissaries. Considering the easy procurement of good foodstuffs of great importance, the companies have constructed markets and commissaries in order to sell foodstuffs of everyday need, at moderate prices. In this way, it has been possible to solve certain economic problems that otherwise would have been difficult. Seven markets and commissaries have been constructed at a cost of Bs. 351,937 ($115,000).

Mess Halls. Eight mess halls at a cost of Bs. 137,733 ($45,000) have been constructed to provide an adequate solution of the food problem for bachelors.

Light, Water, Sewage, etc. As an integral part of the various modern facilities in the petroleum camps, good drainage, sewage system, potable water, streets, gas, and electricity are necessary. Excluding cost of housing, this represents an investment of Bs. 1,931,556 ($631,000), to which should be added the cost of similar modern facilities in shops, at wells, and in other sections of the petroleum producing areas. General sanitation, drainage, campaigns against endemic diseases, and other phases of health prevention have been considered a routine obligation and it can well be said that in general, life in the petroleum camps is as healthy as the climate permits.

Churches, Public Buildings. The spiritual welfare of the workers has also received the attention of the management. More than Bs. 50,000 ($16,350) has been spent toward that end. The National or State authorities maintain public order in all the camps.

Summary. From the above, it can be seen that the companies have seriously considered the various social problems affecting their workmen and in their endeavor to solve them, have spent a considerable amount, as summarized below:

	Cost	
	Bolivars	Dollars
Housing	11,095,209	3,624,800
Schools	391,262	127,800
Clubs, sports, etc.	571,480	186,700
Markets, etc.	351,937	115,000
Restaurants	137,733	45,000
Light, water, etc.	1,931,556	631,000
Public buildings	172,208	56,300
Total	14,651,385	4,786,600

A park in the camp of the Standard Oil Company of Venezuela at Caripito

Colombia's Oil Possibilities Being Actively Explored and Developed

Potential production developed during 1938 exceeds that of any similar period in the history of the country—greater pipe-line facilities being provided

By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

THE continued steady climb during the last five years has brought Colombia's production above the high mark previously set in 1929. This increase should be accelerated when the new pipe line from the Barco Concession begins taking oil from that remote district to seaboard. This line should be in service by the end of October and the total production figure for 1939 will probably be increased slightly by shipments from the Barco during the last two months of the year. Greater interest is being shown in the wildcat areas of the country and leasing has been very active during the last year. In fact, Colombia has had the greatest activity in its history in both prospecting and development; more wells were drilled and more potential production established than in any previous year. There are now two active commercial areas in Colombia and it is not improbable that new discoveries will be made in the near future.

Total production from the country during 1938 was 21,660,718 bbl., which brought the total to the end of the year to 227,905,592 bbl.[1]

All crude to the present time has been from the Tropical Oil Company's operations around El Centro and shipped from Mamonal on the Caribbean coast, to which it was piped through the Andian National Corporation pipe line. Exports of Barco crude will soon be shipped from Covinas, the terminal of the South American Gulf Oil Company's pipe line.

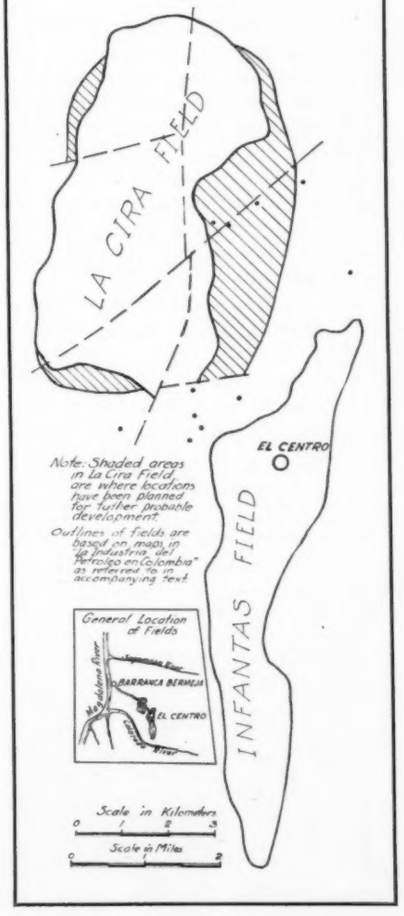
Infantas and La Cira Fields

Tropical Oil Company's production headquarters for operating the De Mares Concession is at El Centro, in the northern part of the Infantas field and southeast of the La Cira field as shown in Fig. 1. El Centro is southeast of Barranca Bermeja, which is on the Magdalena River approximately 500 km. (310 mi.) south of Barranquilla. A narrow-gauge railway 27 km. (17 miles) in length connects Barranca Bermeja and El Centro.

At El Centro are the industrial plants and the main natural gasoline plant of the Tropical Oil Company. At Barranca Bermeja is the company's refinery. Power plants for electrical operations and lighting are at both places but power lines from both plants are interconnected so that each plant supplements the other.

Discovery of the Infantas field was late in 1917 but active development of the field did not occur until 1921. Production from this field in 1938 was 5,473,000 bbl. and the total to the end of the year, 118,209,000 bbl. This field is almost fully developed and only one well was drilled last year.

Fig. 1


LA CIRA FIELD
EL CENTRO
INFANTAS FIELD
Note: Shaded areas in La Cira Field are where locations have been planned for further probable development.
Outlines of fields are based on maps in "La Industria del Petroleo en Colombia" as referred to in accompanying text
General Location of Fields
BARRANCA BERMEJA
EL CENTRO
Magdalena River
Scale in Kilometers
Scale in Miles

The La Cira field was discovered in 1925. Production from this structure in 1938 was 16,109,000 bbl. but its total to the end of the year was only 109,495,000 bbl. Although 500 wells have been drilled in La Cira as compared to 470 in Infantas, 107 of these wells were drilled in 1938 and some have been on production for a very short time. The limits of this field are not yet known but additional wells have been planned for further development in the areas indicated in Fig. 1.

The status of the Infantas and La Cira fields as of January 1, 1939, is shown in Table 1.[2]

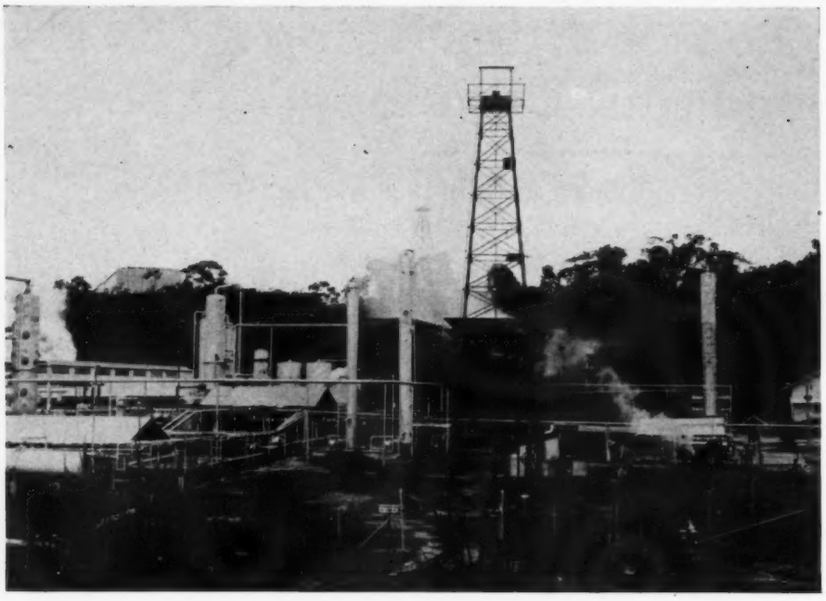
The total production of 21,581,588 bbl. produced by both fields in 1938 included 275,848 bbl. of condensate added to the crude oil.

During the early stages of development, cable tools were employed but these have now been replaced by rotary. The 122-ft. derrick is used. Concrete foundations for the drilling engine are so designed that they provide a base for a skid-mounted pumping unit when the well goes on the pump. The formations are relatively soft and with the exception of a few rock bits, drilling is done with fishtail and drag bits of various design.

In some of the edge wells or at locations of a semi-wildcat nature, a casing string is cemented above the known water sand and tests made by gun-perforating at possible zones indicated by the electrical log. Water or gas sands encountered in this operation are squeeze-cemented to leave only the oil-producing strata open. Gun-perforation has also been used in a number of older wells to obtain production from upper zones previously cased-off. After

[1]From "Petroleum Development in Colombia during 1938," by O. C. Wheeler. *Petroleum Development and Technology, 1939.* Published by A.I.M.E., 29 West 39th Street, New York, N. Y.

[2]From "La Industria del Petroleo en Colombia," by Felix Mendoza, petroleum engineer, and Benjamin Alvarado, geologist, as published by the Ministerio de la Economia Nacional, Departamento de Petroleos.



A view of gasoline plant at El Centro

perforating, the lower zone is either plugged-off or both the old and new sands are produced together, depending on the condition of the lower sand.

It is the present practice to put the wells on the pump as soon as they cease to flow.

The entire producing area around El Centro is electrified by power from the 7000-kw. power plant mentioned. The current is supplied by turbo-generators at 2300 volts, which is stepped-up to 13,000 volts for primary distribution. The potential is stepped-down to 440 volts for field operations.

Individual pumping units are used for most of the wells although there are two central stations or "catalinas" operating 29 wells. The topography and heavy undergrowth, however, do not favor central power pumping. There are also a number of upper sand wells being pumped by jacks operated from the back-side of a deep-sand unit.

Tubing now being used upon completion is 2½ in. but this size is replaced by 2 in. when the well declines. When the well stops flowing, a subsurface pump best suited to the conditions is installed; special pumps are installed for sandy conditions and ordinary sectional-liner and insert-rod type, for cleaner wells. Sucker rods are ¾ in. or ⅞ in., according to depth and volume of production. Speeds and stroke are governed by the well potential and range from 1 to 18 s.p.m., the length of the stroke being from 1 to 5 ft. Greater speeds have been used in some instances.

Electric motors are used for pumping and range in size from 1 to 20 hp. Continuous pumping is favored over intermittent pumping even in the very small wells and by careful study of individual conditions, units have been installed and powered to obtain maximum production at greatest economy. Electric hoists are frequently used for clean-out jobs involving only the pulling of rods and tubing.

About half the oil being produced is dehydrated and a very efficient plant has been built for this purpose. The method used includes heat and chemical treatment, and water extraction in excelsior tanks after the emulsion has been broken.[3]

[3] "Petroleum Industry of Colombia," by Dr. Philip F. Shannon, Ben F. Zwick, Lowell O. Green, Louis W. Minturn, and L. J. Botero. Published in *Mines Magazine*, June, 1939.

TABLE I
Operating Data—Infantas and La Cira Fields

Data	Infantas	La Cira	Total
Present number of wells drilled	470	500	970
Number of wells abandoned to date	19	3	22
Number of wells produced, December, 1938	297	423	720
Average daily net oil production, bbl.	13,561	47,108	60,669
Average daily gas production—M. cu. ft.	28,323	68,202	96,525
Average daily gas returned to sands—M. cu. ft.	6,206	10,788	16,994
Net gas-oil ratio (less gas returned) cu. ft. per bbl.	1,630	1,220	1,310
Number of wells pumped December, 1938	290	366	656
Number of wells flowed December, 1938	7	56	63
Number of wells on artificial lift December, 1938	0	1	1
Number of wells repressuring December, 1938	16	15	31
Input pressure to key wells—lb. per sq. in.	230—485	570—660	235—660
Average gravity of crude produced, deg. A.P.I.	25.0—27.5	20.0—25.0	24.5
Base of crude	Mixed	Mixed	Mixed

The main gasoline plant for treatment of all gas from the Infantas and La Cira fields is at El Centro. Absorption, however, is done at compressor stations of which there are three in the Infantas and two in the La Cira field. Mineral-seal oil is pumped to the compressor stations from the El Centro plant and, when enriched by passing through absorbers at the stations, is returned to the main plant for distillation and stabilization. Approximately 50,000,000 cu. ft. of wet gas is treated per day, obtaining a yield of from 90,000 to 100,000 gal. of gasoline.

All gas produced in the fields is conserved; that not used in field and plant operations or for domestic purposes is returned to the sand for maintaining pressure. Approximately 3,000,000 cu. ft. of residue gas is piped to the refinery at Barranca Bermeja. During the last eight years, an average of 17,000,000 cu. ft. of gas has been injected into the sand daily and has been the means of conserving and utilizing this product efficiently.

The Refinery at Barranca Bermeja

Tropical Oil Company's refinery at Barranca Bermeja began operating early in 1922 and is still the only refinery in Colombia.

Refinery equipment consists of three shell stills, a combination atmospheric and vacuum unit, a phenol plant for lube oils, and a grease plant. According to recent reports,[3] "straight run gasoline and kerosene only are topped off the three shell stills, leaving the residue as a commercial grade of fuel oil. When running the Foster-Wheeler unit in series, aviation gasoline, heavy naphtha and kerosene are taken off the atmospheric side and mineral seal, Diesel fuel, and lube distillate off the vacuum side, running the residue to asphalt.

"The straight run gasoline has a good octane rating. The refinery utilizes the greater amount of natural gasoline produced in the field gas plants by blending with the refinery products.

"Lubricating stocks are phenol treated to meet S.A.E. specifications for the various grades ranging from 20 to 60 S.A.E.

"The residue from the bottom of the Foster-Wheeler unit to be run to asphalt is charged to an oxidizer. Temperature is maintained and air is supplied for oxidization to meet specifications."

Andian Pipe Line

Crude oil for export is transported from the Infantas and La Cira fields through a pipe line extending 335 miles

Another CONTINENT depends on the JOHNSTON TESTER!

SOUTH AMERICA—land of contrasts and superlatives—is the home of the world's *highest* oil field, and also the world's most *inaccessible!* It is a continent of modern streamlined cities—and of trackless savage-filled jungles... of twenty thousand foot peaks and of endless wind-swept plains... of sweltering heat and of freezing cold!

A tough region to explore, South America nevertheless has proved rich in natural resources, among the foremost of which is—OIL! And as long as oil is where you find it, you will also find men and equipment pushing back civilization's frontiers in the never ending quest for new supplies to fill the oil needs of the world.

That's why South America is *another* land on the oil field map where the Johnston Formation Tester is used to cut development costs. Here, transportation of heavy equipment takes weeks and even months of travel up sluggish rivers, over mountains, and through jungles... rigging up to drill has required as long as *two years* of initial preparation... and every well that's drilled represents a fortune spent for labor, equipment and supplies.

So these operators take no chances. They *know,* with the Johnston Tester, the exact production possibilities of every sand they drill BEFORE CASING IS SET... which sands are wet, which are dry, and which will produce results. *Knowing* this, operators set casing in exactly the right spot, making each string do the work of several, and save thousands of dollars on transportation costs of needless items. They drill their wells more *economically,* more intelligently... *and get better results while doing it!*

Your program may not involve such development difficulties as these, but it's just as important that you, too, drill your wells this efficient way... that you stretch development dollars... and that you save money on every well you drill. Write *today* for illustrated booklet 210, describing accurate, safe, and dependable Johnston Formation Testing Methods in detail!

M. O. JOHNSTON
Oil Field Service Corp.
3117 SAN FERNANDO ROAD ALbany 0186
LOS ANGELES, CALIFORNIA
Bakersfield 2794 Ventura 5621
"Servicing California and Selling Exclusively Foreign"

FORMATION AND JOHNSTON CASING TESTING

JOHNSTON
Oil Field Service Corp.
5702 NAVIGATION BLVD.
HOUSTON, TEXAS
"Servicing Mid-Continent and Gulf Coast"

"WHY SET CASING BEFORE YOU KNOW!"

from El Centro to Mamonal, a port on Cartagena Bay in the Caribbean Sea and eight miles south of the ancient city of Cartagena. Originally constructed with 10-in. pipe, the line is now looped over almost its entire length by 10-in. and 12-in. pipe and has a present capacity of 55,000 bbl. per day. There are nine pump stations along the line in addition to the loading station at Mamonal.

The pump station at El Centro where the oil enters the line is equipped with four pumping units consisting of 260-hp. Diesel engines driving 5½-in. by 24-in. reciprocating pumps. At two stations, there are three 500-hp. units, and at the other six the oil is pumped by two 500-hp. and two 200-hp. horizontal units.

At Mamonal, the tankers are loaded by four units consisting of 260-hp., 4-cycle vertical engines driving 11½-in. by 24-in. pumps, having a total capacity of approximately 10,000 bbl. per hr. Crude oil is pumped through two 12-in. lines laid on a pier that extends into deep water. A 10-in. line on the pier is used for loading fuel oil and bunker fuel. There are fifteen 80,000 bbl. tanks at Mamonal in addition to a total of 965,000-bbl. storage capacity at the various stations.

During 1938, 19,140,187 bbl. of oil was taken by the pipe line at El Centro, and 18,706,565 bbl. loaded at Mamonal. The total oil pumped through the line to the end of 1938 was 208,808,967 bbl.

Barco Operations

The Barco Concession along the Venezuelan border covers approximately 988,400 acres,[2] of which the Colombian Petroleum Company, operating the concession, has the right to reserve half within the first ten years of its contract with the National government. Reservation of five lots comprising 148,272 acres and covering the structures of La Petrolea, Leoncito, and Carbonera has already been made. Of immediate interest, however, are the Petrolea and Rio de Oro fields, particularly the former, which will soon be connected to the coast by the new South American Gulf Oil Company pipe line.

Although not yet a shipping field, Petrolea had produced to the end of 1938 a total of 180,879 bbl. of oil, of which 60,461 bbl. were produced in 1938. This of course does not reflect the potential production of the field, which is estimated as well over 50,000 bbl. per day from the wells now drilled.

Production in this field comes from zones 1, 2, and 3 in the Cogollo limestone and from the Ostrea zone. Depths of wells are from a little more than 400 ft. to 3000 ft. The oil is light, having an average gravity of 44 deg. A.P.I.

Five drilling rigs are now operating in Petrolea field in which 37 wells had been drilled to the end of 1938. Of these wells, 17 were drilled during the year and development is going ahead rapidly.

With the pipe line from Petrolea to seaboard nearing completion, it is reported that wells are now being put on production and oil being flowed into storage tanks in the field.

At the northern end of the Barco Concession along the De Oro River is the Rio de Oro field. Production from this field in 1938 was 18,700 bbl. and total production to the end of the year was 21,600 bbl. Nine wells have been drilled; and of six producers brought-in, three were completed in 1938. Two rigs are operating in the Rio de Oro field.

The estimated potential of the field at the present time is approximately 7500 bbl. per day.

Depths of producing wells in Rio de Oro range from 1170 ft. to 1615 ft. Two wells were drilled to depths of 6317 ft. and 6717 ft., respectively, but both were abandoned. Production is from a sand known as the Catatumbo; oil from most of the wells averages more than 38 deg. A.P.I. Five wells were flowing at the end of the year.

Exploratory wells have been drilled at a number of locations in the Barco Concession and one rig is now assigned to wildcat work.

Petrolea-Covenas Pipe Line

One of the most outstanding feats of pipe-line construction in the world was that of building the 12-in. welded line from the Petrolea field to Covenas on the Caribbean Sea about 65 miles south of Mamonal, the terminal of the Andian pipe line. (See map of Colombia.) This new line will probably be put in service about the end of October and will be operated by the South American Gulf Oil Company, owned jointly by The Texas Company and Socony-Vacuum Oil Company, Inc.

This line, approximately 256 miles in length, first traverses the Western Range of the Andes, ascending from Petrolea at an elevation of around 700 ft. to a final height between 5000 and 6000 ft. From here, it descends rapidly to the Magdalena Valley, crossing the Magdalena River just north of La Gloria. Its course is then through the swampy river country adjacent to the junction of the Magdalena and Cauca rivers and then to the coast at Covenas.

Oil flows by gravity from the high point in the mountains to the terminal at Covenas. To lift the oil from the field to this point three pump stations were constructed. The capacity of the line is estimated at approximately 25,000 bbl. per day. A refinery having a capacity of 500-bbl. per day will be constructed in the Petrolea field.

In laying the line, four airplane landing fields were constructed and at the most inaccessible locations some of the equipment was flown-in by planes so that work could be started both ways from each air field.

Exploratory Work

Leasing activities in Colombia during the last year have been greatly accelerated and in addition to many concessions granted, there are applications for many more. The leasing activities are mainly along the Magdalena Valley, the Llanos lying east of Bogota toward the Meta and Ornoco rivers, in the vicinity of the headwaters of the Catatumbo River (near the Barco Concession), along the Caribbean coast, and in the southwestern area near the Ecuadorian border.

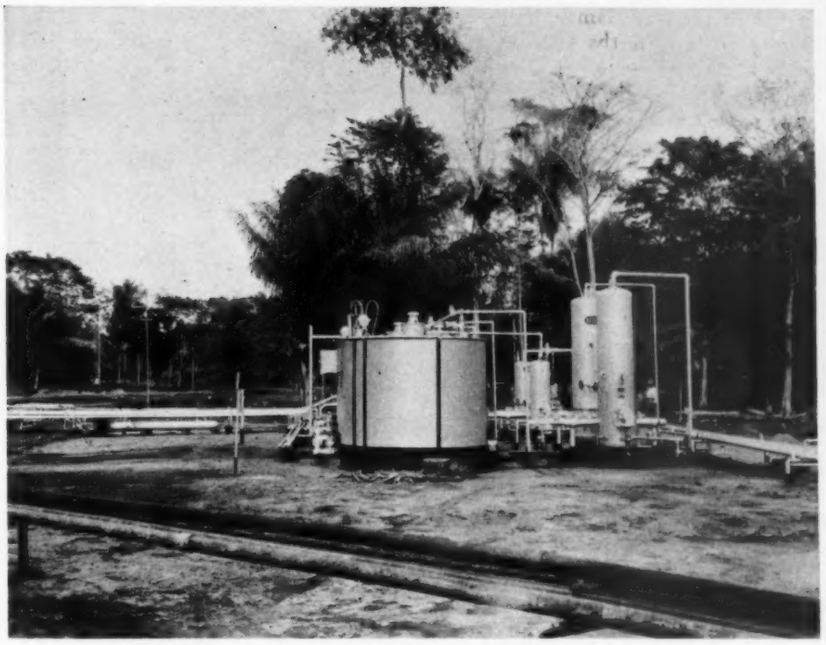
The most extensive exploratory work is being done by Socony-Vacuum Oil Company de Colombia on the Restrepo Concession. The main camp for operations is at Aguas Claras. Recent reports are that No. 1 Nariño was abandoned at a depth of 6500 ft. but did not reach its objective because of mechanical difficulties. No. 2 Nariño, however, is now drilling. The company also has spudded-in No. 1 Peralonso in the north central part of the concession, the location being northeast of the La Nariño wells.

Three wells were drilled sometime ago on the Las Monas structure east of Aguas Claras and one of these has been pumping small amounts of oil.

The Carare wildcat drilled by Tropical is on the San Fernando structure and is in the Carare Concession, owned jointly by the Tropical Oil Company and the Sociedad Nacional del Carare. After being drilled to more than 6000 ft., the first well, No. 1 San Fernando, was abandoned because of mechanical difficulties. No. 2 San Fernando is now drilling.

Farther up the Magdalena River are two tests being drilled by the Shell interests, one near Zambito and the other south of Honda. No progress reports have been received but considerable interest is focused on these wells because of their location.

A "production square" on a lease in Forest Reserve, Trinidad



By

WALLACE A. SAWDON

Pacific Coast and Foreign Editor

Petroleum Development in Trinidad

Efficient methods in field and refinery are key to Island's remarkable progress in oil exploitation

MOVING to third place among South American oil-producing countries, Trinidad in 1938 reached an all-time high of 17,737,061 bbl.,[1] an increase of more than 14 percent over the previous year. Total production to the end of 1938 was 162,818,403 bbl. Average monthly production during the last year was approximately 1,478,000 bbl. but this has been increased substantially during the current year, that for July, 1939, probably passing 1,600,000 bbl.

At the present time between 35 and 40 strings of tools are operating in Trinidad. During 1938, 231 wells were completed, making a total of 2641 wells completed to the end of the year. At that time, 1304 wells were producing and 850 wells had been temporarily shut-in. Of the number producing, 428 were flowing, 516 pumping, 81 on gas-lift, 123 on plunger-lift, and 156 being produced by other methods.[1] Of the volume of oil produced, nearly 70 percent came from flowing wells and more than 10 percent from wells produced by plunger-lift.

[1]Statistics are from "Oil and Gas in Trinidad During 1938" by P.E.T. O'Connor. *Petroleum Development and Technology, 1939.* Published by A.I.M.E., 29 West 39th Street, New York, New York.

The main productive zone in the Trinidad fields is the Cruse series consisting of four sands, best production coming from the lowest of the series. Above this zone lie the Forest and Morne L'Enfer. The structures are anticlines and faulted anticlines and the sands are sometimes lenticular. Formations above the Cruse show more or less unconformity in the various areas throughout the island. Most of the oil from the Cruse sands ranges in gravity from 19 to 22 deg. A.P.I. and that from the Forest from 13 to 20 deg. A.P.I. Gravities to 47 deg. have, however, been reported.

The various fields of Trinidad are shown on the map on page 166. A number of names are used to designate some of the older areas and a few of these names are not given on the map. Forest Reserve has been included with the Fyzabad area and Parryland, Kern, and Cruse in the areas around Guapo and Point Fortin. The fields themselves have been distorted in size on the map in order to bring out their general location more clearly.

Extending from Point Ligoure in a southeasterly direction across the southwest peninsula to Coora is the Guapo fault that has probably influenced oil accumulation in this territory. Oil has, however, been found on both sides of this fault. Coora is being rapidly developed and has become an important area. To the northwest is the Los Bajos field on the north side of the Guapo fault, also an important area. Several wells have been drilled along the fault between these two fields and, being brought-in as producers, have indicated that the entire area separating Coora and Los Bajos is probably productive. Moreover, indications are that production may extend part if not all the way from these two fields to the Palo Seco field to the southwest.

The Penal field northeast of the town of Siparia is one of the newer fields of the island and is now connected with the Point Fortin refinery by a pipe line. This is a shallow pumping area, production consisting of the heavier oil from the upper zones.

Extensions to the older fields around Point Fortin and in the Fyzabad area and deeper drilling to the Cruse sands have increased the known reserves to a considerable extent. Maximum depth thus far drilled on the island has been slightly more than 9000 ft. in a test

in the Fyzabad area. Completions are usually at depths from 2000 to 4000 ft. in the Cruse series although many wells are deeper. High gas pressures are encountered even at comparatively shallow depths and the use of heavy mud and suitable blowout preventers or other surface control equipment is necessary.

Drilling fluid is made with native clays to which weight material is added when high pressures are to be encountered. The mud is generally weighted to 120 lb. per cu. ft. but in many cases is increased to 130 lb. Colloidal properties are imparted to the mud by the shale formations but the mud made by these shales sometimes reaches a very high viscosity. During drilling, the mud is thinned by chemical compounds.

Electrical logging has become general practice and has supplanted the taking of actual cores to a considerable extent. Gun-perforating is widely used to meet the requirements of certain conditions. The deviation from vertical in well bores is controlled by the use of survey instruments.

Very fine, loose, unconsolidated sands cause considerable trouble throughout the life of the wells. Flowing wells are produced through beans and a back pressure is carried on the sand. This excludes the sand as well as reduces the gas-oil ratio, which in many cases is rather high.

Both individual units and central powers are used for pumping wells. Most of the units employ the conventional gas-engine drive; several steam units are in use that operate in the manner of a locomotive cylinder having a trip at the top of each stroke to actuate a valve and allow the rod and piston to fall. Subsurface pumps are of various types; depth of well and potential influences the kind selected. A great many of the wells are now on plunger-lift as noted above.

Steam-operated pump, used on some wells in Trinidad

In general practice, an oil-gas separator is employed, in which the gas is taken-off before the oil goes to field storage. Separators and field tanks are frequently arranged in "production squares" that are made-up of batteries consisting of the number of units required to accommodate all the wells that can be flowed to the location conveniently. In some instances, both the field storage tank and the separator are placed at the well to form a complete production unit at one location.

Gas production during 1938 was approximately 18,500,000,000 cu. ft. Most of this gas is processed in the gasoline plants situated in all the producing areas, one of which is a charcoal adsorption plant. Repressuring is being done to some extent and one company has been storing gas in the sand.

Refinery expansion has been in progress for the last two or three years. The largest refinery in Trinidad, operated at Pointe-a-Pierre by the Trinidad Leaseholds, Ltd., now has a daily capacity of approximately 25,000 bbl. Extensive additions are also to be made soon to the United British Oilfields refinery at Point Fortin, present capacity of which is 5000 bbl. per day.

Exploratory Work

Wildcatting is very active on the island and is being conducted in the areas indicated on the map of Trinidad. All production thus far has been from the southern part of the island below the Central Range. Two wells north of this range are now drilling, however, in what is called the northern basin and the progress of these wells is being given close attention. Locations were made by seismograph survey correlated with geological work. Both wells are scheduled for depths of 10,000 ft., or deeper, if necessary. Should discoveries not be made in the first wells, further tests will be made. One well is being drilled by United British and the other by Trinidad Leaseholds. Heavy Diesel rigs are being used and 136-ft. derricks.

According to reports as of the end of 1938,[1] there have been 4 wells completed in the Mayaro district, 4 at Moruga, 6 at Cedros, 6 at Morne Diable, 1 at Erin, and 1 at Point Ligoure. Limited data have been made available concerning the operations or the possibilities disclosed by the tests. It is understood, however, that some encouraging results have been obtained.

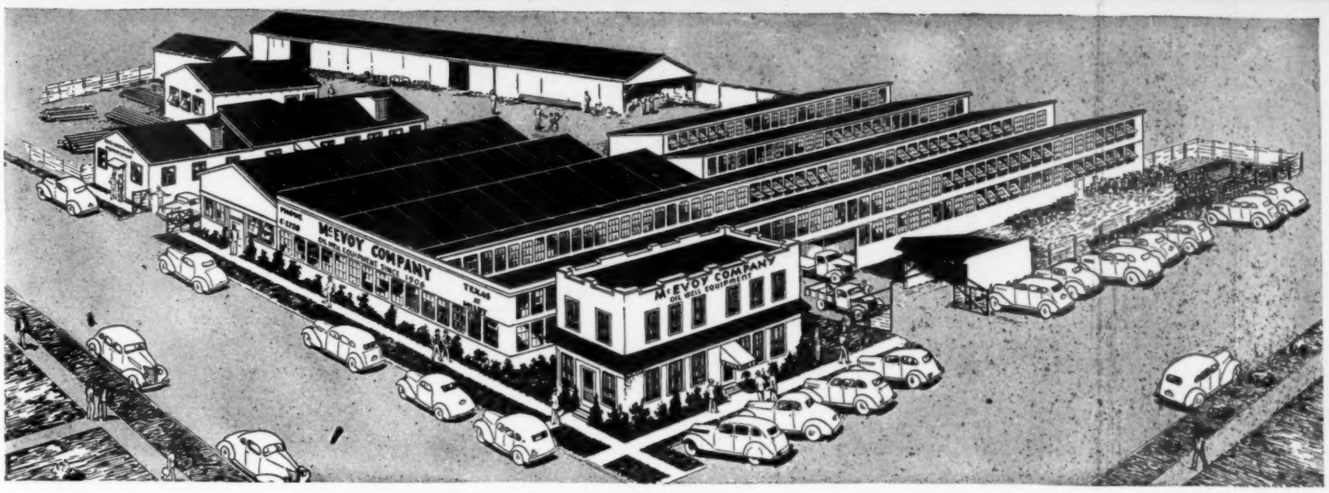
A recording truck being set-up to make a reflection seismographic survey

(Photo courtesy United Geophysical Company)

Why the New McEVOY COMPANY GIVES YOU BOTH

★ GOOD EQUIPMENT

★ *and* GOOD SERVICE



THIS *New* MANAGEMENT

GUS. S. WORTHAM
President

GEORGE S. WATSON
Executive Vice President and General Manager

GEORGE A. BUTLER
Counsel

A. HENDERSON
Vice President in Charge of Production

J. H. McEVOY
Vice President

J. H. HOWARD
Chief Engineer

PLUS Ample added resources . . . Modernized plant . . . Precision machinery . . . Facilities for fast and complete service.

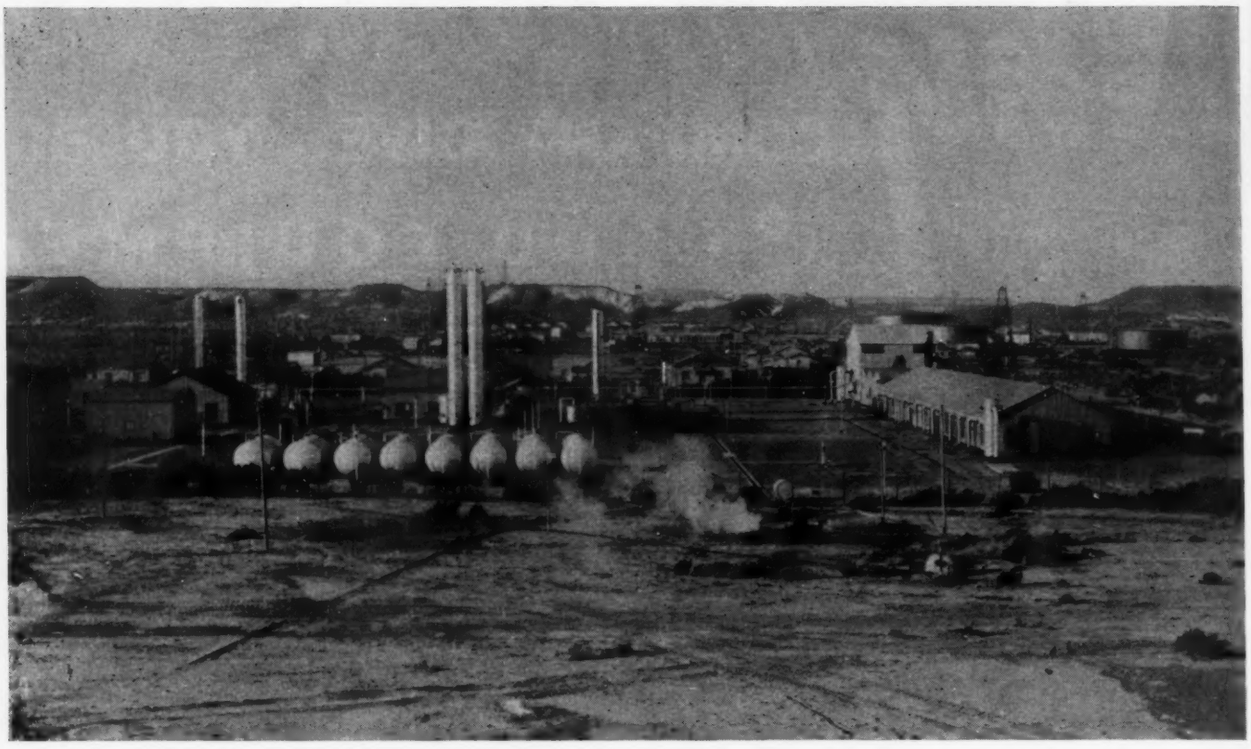
PLUS Oil well products of the very highest quality, in line with the McEvoy tradition since 1906 . . . Products that are being progressively improved to fully meet the most exacting and timely requirements of the oil fraternity.

LEADING MAJORS AND INDEPENDENTS are expressing their appreciation of this kind of progressive, reliable service WITH REPEAT ORDERS.

McEVOY COMPANY
"OIL WELL EQUIPMENT"
TEXAS AT MILBY • HOUSTON, TEXAS

Since 1906

Export Sales Division
OILFIELD EQUIPMENT CO., Inc.,
30 CHURCH STREET, NEW YORK.



Natural gasoline plant in the Comodoro Rivadavia area

Natural Gasoline Plants in Argentina Employ Up-to-Date Processes

Oil absorption method has become more widely adopted—compression-type plant is used in conjunction with repressuring project

By the Staff of the Yacimientos Petrolíferos Fiscales (Y.P.F.)

THE first plant for extracting natural gasoline from natural gas in Argentina was an adsorption-type plant installed in 1922 by Yacimientos Petrolíferos Fiscales (Y.P.F.) in the Comodoro Rivadavia field.

This plant had an initial capacity of 30,000 cu. m. (1,059,435 cu. ft.) per day. In early 1928 it was replaced by a new charcoal adsorption plant having a capacity to treat 120,000 cu. m. (4,237,740 cu. ft.) of gas per day.

Because the production of gas was increasing continuously, an oil absorption plant was installed during the latter part of 1928. This plant was in turn modernized and enlarged in 1933 for the purpose of increasing the yield by more efficient extraction of the more profitable gasoline fractions.

In addition to the extraction of all pentane and higher fractions the new plant permits the extraction of 70 percent of the butane and 16 percent of the propane contained in the gas, thus obtaining production of the so-called liquefied gases that are utilized in Argentina for refrigeration and as fuel for motor vehicles in the oil fields.

The present plant has a capacity to treat 350,000 cu. m. (12,360,100 cu. ft.) of gas per day. Two absorbers are

PETTY
PAVING THE WAY
In South America
PETTY GEOPHYSICAL ENGINEERING COMPANY SAN ANTONIO TEXAS

used, operating at a pressure of 3.5 kg. per sq. cm. (50 lb. per sq. in.).

The residue gas from this plant is consumed in the field as fuel, etc., and the excess is returned to the producing formation.

The "wild" gasoline extracted from the absorption medium is then treated in two fractionating towers to obtain stabilized gasoline and supergas (liquefied gases).

Other installations in the Comodoro Rivadavia field include an oil absorption plant owned by Compañía Ferrocarrilera (the railroad company), and a compression plant erected by the Diadema Argentina Company.

Y. P. F. installed its first gasoline plant in the Plaza Huincul field in 1932. This adsorption-type plant was replaced in 1936 by a modern oil-absorption plant having a capacity to treat 100,000 cu. m. (3,531,450 cu. ft.) of gas daily, extracting all pentanes and higher.

The operation of this plant is similar to that of the plant in the Comodoro Rivadavia field, the only difference being that the Plaza Huincul plant does not have the two fractionating towers, because the latter plant only absorbs a small volume of the liquefied gases, butane and propane. Stabilization of gasoline is done in this plant in a small tower, to remove the more volatile fractions from the finished gasoline.

The Standard Oil Company also operates a compression-type gasoline plant in the Plaza Huincul field.

In the Salta field, natural gasoline is extracted in two plants owned by Y. P. F., and the Standard Oil Company, an adsorption plant and a compression plant, respectively.

The gasoline plant installed by Y. P. F. in the Tranquitas field has a daily capacity of 50,000 cu. m. (1,765,700 cu. ft.), employing three absorbers, operating at a pressure of 2.5 kg. per sq. cm. (36 lb. per sq. in.)

The compression-type gasoline plant owned by the Standard Oil Company in the Tranquitas area is situated at San Pedrito, 100 km. (62 mi.) north of Vespucio. This plant is operated in conjunction with the compressors used in returning the gas to the producing formation to maintain the reservoir pressure and to prolong the flowing life of the wells.

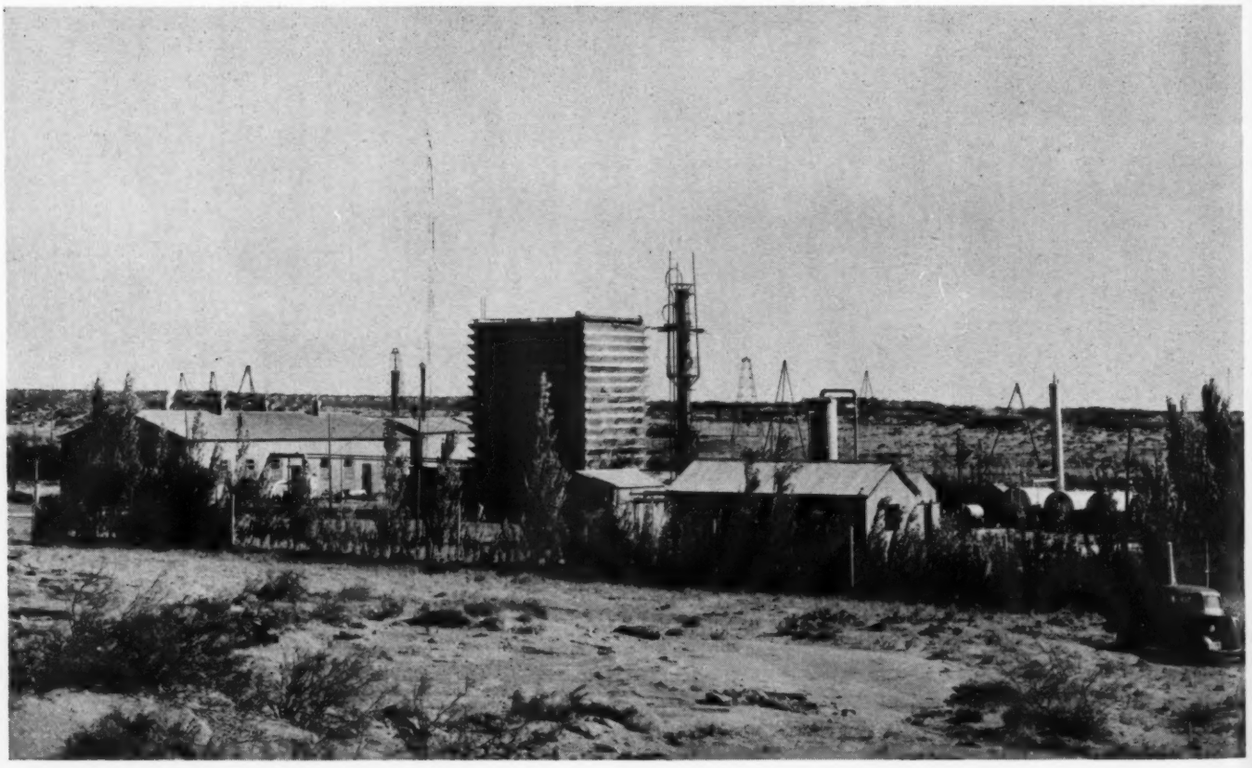
Formerly the Standard Oil Company owned another compression plant at Tablitas, near Vespucio, but this plant is not in operation at present.

Installation of a new compression plant will be completed next year by Y. P. F. in the Rio Pescado encampment (Province of Salta).

The accompanying table shows the volume of gasoline extracted from the natural gas in the various oil fields during 1938.

Name of field: **Comodoro Rivadavia** / Name of operator:	Volume of gas treated		Volume of gasoline produced	
	cu. m.	M. cu. ft.	liters	gal.
Fiscal Oil Fields (Y.P.F.)	85,958,154	3,035,570	8,848,427	2,337,489
Diadema Argentina	10,900,000	384,930	1,028,000	271,567
Railroad Company	130,500,000	4,608,540	261,000	68,948
Plaza Huincul				
Fiscal Oil Fields (Y.P.F.)	17,399,380	614,450	2,228,001	588,471
Standard Oil Company	7,400,000	261,330	1,289,000	340,515
Salta				
Fiscal Oil Fields (Y.P.F.)	8,670,907	306,210	1,313,317	346,939
Standard Oil Company	37,685,000	1,330,830	8,621,000	2,277,410

Natural gasoline plant in the Plaza Huincul area



Marine production in the Comodoro Rivadavia area

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

By
The Staff of the Yacimientos Petroliferos Fiscales
(Y. P. F.)

Intensified Operations in Existing Fields Have Characterized Argentina Oil Industry

Increased production, despite a decline in the number of wells, has resulted from study of production problems—all fields prorated to maintain formation pressure

THE volume of oil produced in the Y.P.F. fields of Argentina has increased steadily from 1935 to and including the first 8 months of 1939. Thus from a production of 943,846 cu. m. (5,936,580 bbl.) in 1935, the production increased to 1,430,599 cu. m. (8,998,150 bbl.) in 1938, an increase of 51.57 percent.

It is interesting to note that this increase was not the result of any new fields discovered, which would certainly have increased production, but, with the exception of the new Tupungato pool in the Province of Mendoza, now in its earliest stage of development, the increase has been the result of intensified operations in fields already producing.

The figures in Table 1 show the production from the various oil fields for the years 1936, 1937, 1938, and the first 8 months of 1939.

Of this increase of 121,711 cu. m. (765,500 bbl.) in the 1937 production, 133,886 cu. m. (716,300 bbl.) (93.6 percent) was from the Comodoro Rivadavia fields and the rest was from Salta and Mendoza fields in amounts of 5877 cu. m. (45,000 bbl.) (5.9 percent) and 4181 cu. m. (26,300 bbl.) (3.4 percent), respectively. The increase in 1938 was 168,713 cu. m. (1,061,160 bbl.) over the previous year with 147,115 cu. m. (925,300 bbl.) (87.2 percent) produced by the Comodoro Rivadavia fields, 8842 cu. m. (55,600 bbl.) (5.2 percent) by the Salta field, and 15,400 cu. m. (96,900 bbl.) (9.1 percent) by the Mendoza fields.

These figures also show an increase for the first eight months in 1939 over the same period in 1938 as follows: 35,858 cu. m. (225,540 bbl.) (27.7 percent) from Comodoro Rivadavia fields, 22,416 cu. m. (140,990 bbl.) (17.3 percent) from Plaza Huincul, 23,891 cu. m. (150,270 bbl.) (18.4 percent) from Salta, and 47,220 cu. m. (297,000 bbl.) (36.4 percent) from Mendoza. This represents a total increase of 129,385 cu. m. (813,800 bbl.).

It is interesting to note from the figures in Table 2 the part that the State has played in the production picture during the last 6 years. These figures give the total production for

(Continued on Page 210H)

TABLE I
Production

Year	Comodoro Rivadavia		Plaza Huincul		Salta and Jujuy		Mendoza		Totals	
	cu. m.	bbl.	cu. m.	bbl.	cu. m.	bbl.	cu. m.	bbl.	cu. m.	bbl.
1936	1,018,299	6,404,900	79,010	496,960	33,298	209,440	9,581	60,260	1,140,188	7,171,560
1937	1,132,185	7,121,190	76,777	482,910	39,175	246,400	13,762	86,560	1,261,899	7,937,060
1938	1,279,300	8,046,500	74,133	466,280	48,017	302,020	29,162	183,420	1,430,612	8,998,220
1939 (8 mo.)	870,783	5,477,000	68,887	433,280	49,614	312,060	60,018	377,500	1,049,302	6,599,840

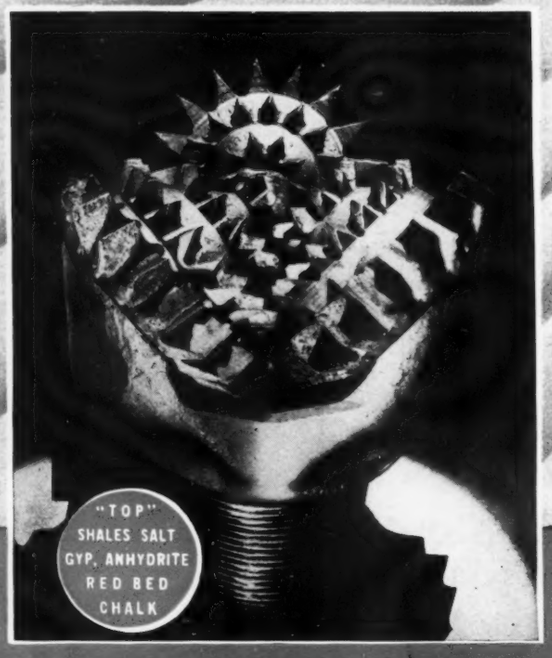
Keep a HUGHES

for a Fast, Straight Full Gage Hole!

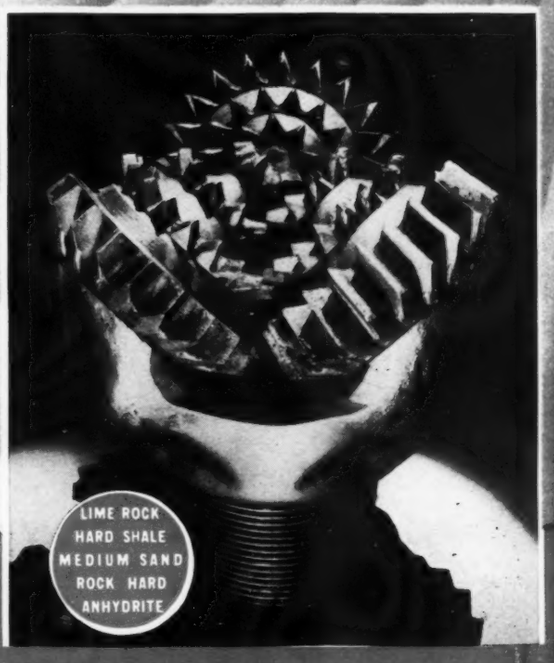
For 30 years Hughes Tool Company has accepted as its obligation: the making available to the Drilling Industry, a safe, fast, economical rotary rock bit.

Constant field and laboratory research, involving enormous expenditure, is proof that a large part of every dollar spent TODAY for Hughes Tools is devoted to development of better means and methods to meet tomorrow's needs.

Hughes Rock Bit of 30 years ago was O. K.... Let the superior performance of today's Hughes Tailor-made Tricone Rock Bit prove to you it is still O. K. as your best investment for "making hole."



Series "OS"—Hughes Rock Bit



Series "D"—Hughes Rock Bit

S BIT "ON BOTTOM"

- and for Certainty of CORE -

For conventional coring — the Industry has found the Hughes Type "J" Core Bit — certain, safe and exceptionally fast cutting.

Hard and Soft formation Cutter Heads are easily interchangeable, thus affording the proper bit for varying formations.

Hughes Tool Co., Houston, Texas, U.S.A.

Series "W"—Hughes Rock Bit

Series "HR"—Hughes Rock Bit

(Continued from Page 210E)

TABLE 2
Production by Y. P. F. and by Private Companies

Year	Y.P.F. production			Private production			Total production in Argentina	
	cu. m.	bbl.	percent	cu. m.	bbl.	percent	cu. m.	bbl.
1934	835,564	5,255,500	37.5	1,394,150	8,768,900	62.5	2,229,714	14,024,400
1935	943,846	5,936,600	41.5	1,329,131	8,360,000	58.5	2,272,977	14,296,600
1936	1,140,191	7,171,600	46.4	1,317,354	8,285,900	53.6	2,457,545	15,457,500
1937	1,261,899	7,937,070	48.5	1,338,208	8,417,030	51.5	2,600,107	16,354,100
1938	1,430,599	8,998,150	52.7	1,284,224	8,077,490	47.2	2,714,823	17,075,640
1939 (8 mo.)	1,049,302	6,600,000	54.4	878,278	5,524,180	45.6	1,927,580	12,124,180

TABLE 3
Number of Producing Oil Wells

Year	Comodoro Rivadavia	Plaza Huincul	Salta and Jujuy	Mendoza	Totals
1936	1479	169	74	25	1747
1937	1567	168	63	30	1828
1938	1463	178	75	36	1952
1939 (8 mo.)	1601	167	77	33	1878

TABLE 4
Production Methods

Field	Pumping		Flowing		Other methods	Totals
	Mechanical	Pneumatic	Natural	Artificial		
Comodoro Rivadavia	1543	0	24	14	20	1601
Plaza Huincul	109	48	9	1	0	167
Salta and Jujuy	11	44	21	1	0	77
Mendoza	24	0	9	0	0	33

TABLE 5
Drilling Footage

Year	Comodoro Rivadavia		Plaza Huincul		Salta and Jujuy		Mendoza		Totals	
	m.	ft.	m.	ft.	m.	ft.	m.	ft.	m.	ft.
1936	111,225	364,910	21,476	70,460	11,357	37,260	10,464	34,330	154,522	506,960
1937	161,467	529,750	14,940	49,020	10,049	32,970	12,101	39,700	198,557	651,440
1938	166,521	546,330	10,401	34,120	12,303	40,360	12,598	41,330	201,823	662,140

TABLE 6
Distribution of Drilling Apparatus by Fields

Year	Comodoro Rivadavia		Plaza Huincul		Salta and Jujuy		Mendoza		Totals	
	On exploitation and deepening wells	On exploration and structural wells	On exploitation wells	On exploration wells	On exploitation and deepening wells	On exploration wells	On exploitation wells	On exploration wells	On exploitation and deepening wells	On exploration and structural wells
1936	24	12	6	8	5	10	0	10	35	40
1937	23	15	2	8	5	6	3	4	33	33
1938	21	10	2	3	4	5	2	4	29	22

Wells Completed Each Year by Fields

Year	Comodoro Rivadavia		Plaza Huincul		Salta and Jujuy		Mendoza		Totals	
	Exploitation and deepening wells	Exploration and structural wells	Exploitation wells	Exploration wells	Exploitation and deepening wells	Exploration wells	Exploitation wells	Exploration wells	Exploitation and deepening wells	Exploration and structural wells
1936	114	23	19	11	14	3	0	16	147	53
1937	156	31	7	8	8	7	14	10	185	56
1938	155	22	7	9	8	3	7	6	177	40

this period both by private enterprises and by the government agency, Y.P.F.

Table 3 reveals that the increase in production by Y.P.F. is not the result of a greater number of producing wells. The figures show the number of producing wells as of December of each year to 1938, and as of August 31, 1939.

In Table 4 are given the various methods employed in the production of oil as of August 31, 1939.

Production in the new fields is on a proration basis in order to maintain the formation pressure. The proration is in accordance with the type of field, whether with or without gas pressure, but in all cases restricted production is enforced, based on the potential of the wells and engineering studies of their characteristics.

Among the fields are: El Trebol and Manantiales Behr in Comodoro Rivadavia, Tranquitas in Salta, and Tupungato in Mendoza.

In connection with the proration in the new fields the use of pressure-recording instruments and sample extractors in the wells has been adopted almost simultaneously with the adoption of such equipment in the United States; consequently, experience has shown which methods are best suited for production in the fields of Argentina.

Because operations in the above-named fields were begun only recently it is not possible to offer concrete results. The producing wells in the Tupungato pool, however, offer an interesting example; one of these wells has been producing continuously for one year under restricted production without decrease in production or reservoir pressure; neither has this well shown any increase in gas-oil ratio. This well was the "discoverer" of the pool, and subsequent wells drilled in the same pool show characteristics similar to those of the original.

The intensity in drilling operations by Y.P.F. is reflected in the amount of hole drilled, increasing from 154,522 m. (506,960 ft.) in 1936 to 201,823 m. (662,150 ft.) in 1938, as shown in Table 5.

It is interesting to note that the increase in the total footage drilled is not the result of any increase in size of drilling equipment, but it has been the result of better service from the equipment used, caused by the adoption of up-to-date labor and material methods and by the exclusive use of rotary equipment.

Table 6 shows the distribution by fields of drilling apparatus and the number of wells by fields completed each year.

THE WORLD'S *Most Complete* GEOPHYSICAL RESEARCH LABORATORY

Whether it be on the coast of Argentina, among the towering peaks of Peru, beside the rivers of Brazil, under Lake Maracaibo, or in the jungles of Venezuela, geophysical work is dependent upon *research*.

WESTERN GEOPHYSICAL COMPANY has the most complete research laboratory of its kind in the world, employing 42 technicians, using the most modern equipment available.

WESTERN draws from the cumulative experience of a large number of field crews operating in diverse localties and engaged in the solution of all types of geological problems. Twenty complete seismograph crews are in operation at the present time.

WESTERN designs and manufactures in its own shops all the geophysical instruments and equipment required for the operation of its field crews.

WESTERN designs and manufactures in its own shops all types of drilling equipment for seismograph work, from a small portable drill unit which may be carried by hand to a large unit mounted on a three-ton truck capable of drilling holes to 1800 feet in depth.

WESTERN GEOPHYSICAL COMPANY, through years of experience and research in field and laboratory, is fully equipped to meet the needs of operators who demand the finest available Reflection Seismograph Surveys. Its trained and experienced personnel, using the most modern equipment, is pledged to unexcelled performance. Fully trained and experienced seismograph crews are maintained for work in any part of the world. Correspondence is invited.

CABLE ADDRESS "WESGECO"

Western

GEOPHYSICAL COMPANY

HENRY SALVATORI, PRESIDENT

MAIN OFFICE
EDISON BLDG., LOS ANGELES
CALIFORNIA

MID-CONTINENT OFFICE
PHILCADE BLDG.
TULSA, OKLA.

Refineries of Argentina Include Well-Balanced Plants

Unusually large demand for industrial fuel oil, necessitating importation of part of supply, makes it desirable to avoid excessive cracking to coke except in special instances

By the Staff of the Yacimientos Petrolíferos Fiscales (Y.P.F.)

THE Argentine Republic, through its agency, Yacimientos Petrolíferas Fiscales (Y.P.F.), owns, at the present time, 13 refineries, three of which are complete with units for the manufacture of fuels and lubricants. All are situated in the proximity of Buenos Aires, which, together with the province of the same name, consumes the greater proportion of refined products used in Argentina.

In addition to the above plants, there is now under construction a refinery at Salta and one at Mendoza, each having a daily capacity for refining 300 and 500 cu. m. (1887 and 3145 bbl.) of crude oil, respectively.

Among other refineries specializing in refining fuel products, the principal ones are the two owned by Y.P.F. at San Lorenzo and Santa Fe, and the one at Dock Sud, Buenos Aires, owned by the Diadema Argentina Company.

The refinery owned by the railroad company in the Comodoro Rivadavia field and the refineries owned by the Nativa and Isaura companies in the port of Bahia Blanca, south of the province of Buenos Aires, deserve mention.

Table 1 shows the capacity of the various refineries in Argentina.

Refining of crude oil in Argentina, amounting to 271,200 cu. m. (1,705,790 bbl.) in 1922, solely of gasoline and other fuels, increased to 2,152,000 cu. m. (13,535,600 bbl.) in 1930, and to 3,545,910 cu. m. (22,303,000 bbl.) in 1938.

All refined products used for lubrication and machine power are manufactured in Argentina. These products fulfill the specifications established in the United States and Europe, and they can compete, in quality and price, with any similar products refined anywhere in the world.

The increase in capacity in the refineries of the Republic, together with the continued improvement in the quality of the refined products, have caused an appreciable decrease in the importation of finished petroleum products, particularly of burning oils and fuels for internal combustion engines, lubricating oils and greases of all grades, and special products, such as insecticides, heavy lubricants, liquid vaselines, etc.

The refineries in Argentina refine, principally, domestic crude oil produced in the fields of Comodoro Rivadavia, Salta, Plaza Huincul, and Mendoza. Only crude oil possessing special qualities is imported. This imported oil, such as that from the Mid-Continent (Oklahoma City), and low-cold-test stock from Peru, is used in refining lubricants.

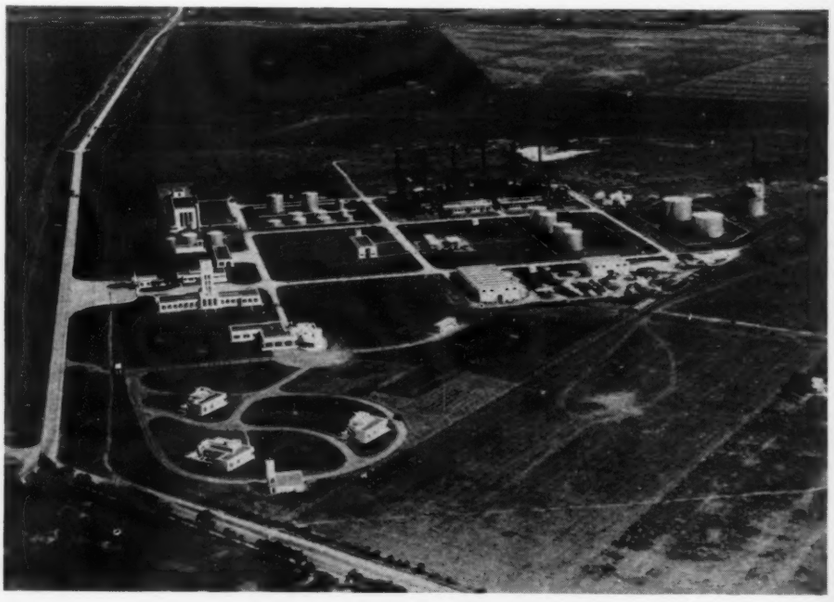
Products of the refinery at La Plata owned by Y.P.F. include 25 grades of industrial oils and 12 grades of greases, including those having calcium, soda, and aluminum bases. All these products are derived solely from Argentine crude oil produced from the Comodoro Rivadavia and Plaza Huincul fields.

Refining of lubricants from crude petroleum produced in the Comodoro Rivadavia area, which, according to the classification by the Argentine Bureau of Mines, is a medium-base oil, has been possible through the modern installations in the LaPlata refinery.

The special crude from Comodoro Rivadavia is reduced at atmospheric pressure in the topping plant to obtain naphtha and kerosene. The reduced crude oil is then subjected to further refining in the vacuum unit at a temperature of about 400°C. (752°F.) and an absolute pressure of 70 mm. of mercury. It is then processed in the "bubble" tower at a pressure of 40 mm. of mercury. Steam is injected at the base of the tower, thus extracting all lube fractions, including cylinder stock, and leaving an asphaltic residuum used in the production of cut-backs and in the manufacture of various types of solid and liquid asphalts.

As the crude from Comodoro Rivadavia contains naphthenic acids, a diluted solution of caustic soda is introduced to neutralize the acids.

The lubricating stocks, after being neutralized, are then submitted to a sulphur trioxide liquid treatment, regulating the temperature to between 30° and 35°C. (86° and 95°F.), and a working pressure of 3.5 to 5 kg. per sq. cm. (50 to 71 lb. per sq. in.), de-



Aerial view of refinery at San Lorenzo

ELIMINATE...

COSTLY *Gas* INTERFERENCE

ON PUMPING WELLS BY USE OF McCOY MECHANICAL

OIL/GAS SEPARATOR

The method of eliminating solution gas in oil by the McCoy mechanical separator is similar to the action which takes place when "pop" is shaken. When agitated, the gas is freed from the liquid and escapes.

How would you like to *substantially increase* your daily oil production... at the same time, reduce your operating and maintenance costs? Major producing companies and independent operators alike are doing it... a fact based on the performance of over 300 pumping wells equipped with McCoy mechanical gas/oil separators... In some instances production has been DOUBLED and TRIPLED after installation of the McCoy mechanical separator, and in almost every installation this equipment *has paid for itself* within a week.

The method, entirely proved over a period of many years, is simple and positive in action. Its purpose is to free solution gas from oil by agitation in addition to releasing free gas before the oil is drawn into the pump at the bottom of well. The result is:

Increased production, less rod breakage, elimination of paraffin troubles in pump, no more sanded-up pumps, prevention of burned stuffing boxes, less wear on equipment and great reduction of down time.

The McCoy mechanical separator is nothing short of sensational. Further investigation of its profit-paying advantages will be well worth your time. So, why not write for complete details, including actual performance records, now!

The mechanical separator, set on spring is actuated by movement of tubing.

What It Has Done

- Increased production of many wells in Illinois (by elimination of gas lock in pumps).
- Eliminated paraffin in wells in Fitzgerwo fields (by stopping gas refrigeration in tubing).
- Reduced Sucker Rod breaks in Seminole field (by eliminating gas pound).
- Eliminated sanding-up of pump in West Texas (by providing constant flow into tubing thru pump, thus preventing sand from settling around pump).
- Increased pump efficiency in Louisiana (by allowing pumps to produce to capacity on dead degassified oil).
- Stopped burning-out of stuffing boxes in Arkansas (by eliminating heads and keeping wells pumping steadily).
- Prolonged life of surface equipment (by eliminating gas from oil).
- Reduced down time wherever the McCoy Separator is installed.

These Advantages are being enjoyed everywhere the McCoy Separator is used!

Manufactured and Distributed by

CARSON

MACHINE & SUPPLY CO.

General Offices & Factory, Oklahoma City, Oklahoma

Illinois Basin Distributor: CHAS. F. SCOTT, SALEM, ILL.

Sold Through All Leading Supply Stores

pending upon the viscosity of the oils refined.

The oils thus treated at the Edeleanu plant are given a light acid treatment in a centrifugal plant and are then contacted with clay obtained from Comodoro Rivadavia, found to be very suitable for this purpose.

The above steps in the refining of lubricants are made in rapid succession in order to avoid storage of the lubricants in process for more than 24 hours, as the oxygen in the air affects their quality, rendering refining difficult and requiring an excessive use of chemical products.

The oil thus refined is diluted by naphtha and the paraffin content is extracted in a De Laval centrifugal plant for medium-grade oils; in the latter plant, the paraffin is separated from the light oil in filter presses.

The paraffin obtained in the La Plata plant is "sweated" in a conventional installation to obtain paraffins of 49° or 50° C. (120° to 122° F.) melting point grade, the paraffin having the greater demand in the local market.

Heavy oils free from paraffin are refined in an atmospheric plant wherein the naphtha content is extracted and these oils are then re-refined in a vacuum steam-injection plant, producing three grades of oils corresponding to S.A.E. 30/40, S.A.E. 40/50, and S.A.E. 60/70, obtaining also a fourth grade of cylinder oil having the higher viscosity of 200 Saybolt Universal seconds at 99°C. (210°F.).

In the refining of lubricants from Mid-Continent crude oils and other special crude oils imported solely for the refining of lubricants, the usual method is employed of vacuum refining, acid treating, removing paraffin, vacuum double refining, and treating to obtain a good-colored bright stock.

In refineries of limited capacity, the unrefined lubricant is mixed with gas oil and is treated by sulphuric acid at a temperature of less than 10°C. (50°F.), decanting the sludge and the paraffin in special filters. The oil is then treated by acid and clay and refined again with steam injection.

In the manufacture of asphalts for cut-back roads, the residues in the vacuum and steam-refining plants are utilized, and "blown" asphalts are used in the preparation of solid asphalts; the qualities of the latter are the same as those of similar products manufactured in the United States.

The watery asphalt emulsions are prepared as "blown" asphalt, which is in turn emulsified by chemical agents to produce colloidal suspensions.

Oxidation of asphalt is done either in cylindrical stills or in vertical tanks. One oil company in the Argentine is installing a plant for the production of "blown" asphalts, equipped with a vertical oxidizer, of which there are now many in operation in the United States. The heating of asphalt preliminary to the oxidation will be done in this new plant by an indirect method, circulating gas oil at an adequate temperature through the equipment, heating the gas oil in a tubular still. In this manner it is hoped to obtain a more uniform temperature control of the products and a better fuel efficiency.

Special products prepared from lubricating stocks, such as liquid vaselines, are manufactured by small concerns from oils bought from the large refineries, as the latter, with few exceptions, do not produce any of these specialty products.

For the preparation of fuels, such as naphtha (gasoline) for automobile engines, the Standard Oil Company's refineries in Argentina have cracking units such as Cross, De Flores, Dubbs, and Tube and Tank. The combined unit recently installed at the San Lorenzo refinery is equipped with Gyro steam cracking.

In one refinery where the crude petroleum from Comodoro Rivadavia, notable for its low content of light distillates and high asphalt content, is treated, the reduced crude is submitted to a cracking process in tubular stills to reduce viscosity. This is done to obtain the greatest possible yield of gas oil, which in turn is then submitted to cracking in the Cross unit.

In plants not equipped with viscosity-reducing units, the crude oil is cracked in a Dubbs unit, running "non residuum" to coke if necessary.

In the Argentine Republic, fuel oil for industrial purposes is consumed in such large quantities that it is necessary to import 1,100,000 cu. m. (6,918,800 bbl.) of fuel oil per year, in addition to the 1,370,536 cu. m. (8,620,400 bbl.) of domestic production. Under these circumstances, cracking until coke is obtained is justified only in special cases, as in the case of the

TABLE I

Capacity of Refineries in Argentina

Company	Field	Area	Crude oil capacity				Annual refining capacity[1]						Type of plant
			Daily		Annual		Naphtha		Lubricants		Fuel oil		
			cu.m.	bbl.	cu.m.	bbl.	cu.m.	bbl.	cu.m.	bbl.	cu.m.	bbl.	
Y.P.F	La Plata	Buenos Aires	5,000	31,450	1,650,000	10,378,100	485,000	3,050,500	24,000	150,950	800,000	5,031,820	Complete
Y.P.F	Vespucio	Salta	80	500	26,000	163,500	5,600	35,220	not operated		17,000	106,930	Topping
Y.P.F	Plaza Huincul	Neuquen	70	440	22,000	138,400	3,600	22,640	not operated		9,500	59,750	Topping
Y.P.F	Godoy Cruz	Mendoza	100	630	30,000	188,700	6,000	37,740	not operated		12,000	75,480	Topping
Y.P.F	San Lorenzo	Santa Fe	1,500	9,400	500,000	3,144,900	225,000	1,415,200	not operated		240,000	1,509,550	Combined
Y.P.F	Campana	Buenos Aires	300	1,890	96,000	603,800	48,000	301,910	not operated		12,000	75,480	Cracking and Topping
Nativa	Campana	Buenos Aires	2,000	12,580	820,000	5,157,600	350,000	2,201,420	22,000	138,380	130,000	817,670	Complete
Nativa	Bahia Blanca	Buenos Aires	545	3,430	170,000	1,069,300	85,000	534,630	not operated		34,000	213,850	Cracking and Topping
Standard Oil	Elordi	Salta	100	630	30,000	188,700	13,000	81,770	not operated		11,500	72,330	Topping
Standard Oil	Plaza Huincul	Neuquen	40	250	13,000	81,800	2,800	17,610	not operated		10,000	62,900	Topping
Diadema Argentina	Dock Sud	Buenos Aires	2,000	12,580	600,000	377,400	270,000	1,698,240	not operated		18,000	113,220	Cracking and Topping
Ferrocarrilera	Comodoro Rivadavia	Comodoro Rivadavia	1,200	7,550	390,000	2,453,000	89,300	561,680	10,000	62,900	261,300	1,643,520	Complete
Ultramar	Dock Sud	Buenos Aires	700	4,400	225,000	1,415,200	120,000	754,770	11,000	69,190	47,000	295,620	Complete
Astra	Comodoro Rivadavia	Comodoro Rivadavia	400	2,520	130,000	817,700	3,000	18,870	not operated		23,000	144,660	Cracking and Topping
La Isaura	Bahia Blanca	Buenos Aires	350	2,200	110,000	691,900	32,000	201,270	not operated		12,500	78,620	Cracking and Topping
El Condor	Avellaneda	Buenos Aires	80	500	26,000	163,500	6,700	42,140	4,000	25,160	1,300	8,180	Topping-Lubricant
Lottero, Papini	Avellaneda	Buenos Aires	90	570	29,250	184,000	8,190	51,510	4,250	26,730	6,435	40,470	Topping-Lubricant
Cia Gral Asfaltos	Wilde	Buenos Aires	30	190	9,750	61,300	not operated		6,500	40,880	1,900	11,950	Topping-Lubricant

[1]Varying, in accordance with crude treated.

JOHNNY'S ON THE SPOT

Back-patting can turn into finger-pointing in a jiffy when per barrel pumping cost is being analyzed from the auditor's cold report.

If the finger points at you—fairly or otherwise—YOU are on the spot, whether or not your name is Johnny.

However, those very cost figures that sometimes paralyze the back-patting hand can also point the way for Johnny to get off the spot, and to stay off permanently.

Go over the figures again, well by well, and judge them in the light of the conditions that exist in each well and the *type of pump* being used.

In each case where the cost of downtime due to pulling the pump, pump repair, or replacement seems out of line it may pay to use a different type pump or one of different material.

While you are doing this, remember that Axelson manufactures a *complete* line of plunger pumps to meet every known well condition—and that for 46 years the Axelson line has been constantly improved to meet changing requirements.

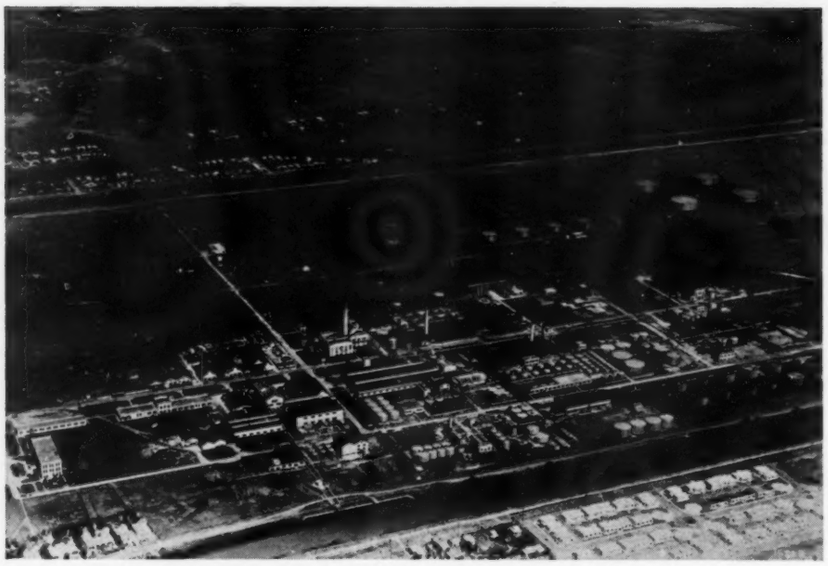
In or near practically every pumping oil field there is a stock of Axelson plunger pumps, pump parts, and pumping accessories.

Talk to an Axelson field man or write to our nearest office—we will promptly send the facts about the Axelson pumps that are being successfully used to cut pumping costs under the same conditions that exist in your troublesome wells.

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

AXELSON MANUFACTURING CO., P. O. Box 98, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa • *Mid-Continent and Eastern Distributor:* Frick-Reid Supply Corp. • *Rocky Mountain Distributor:* Great Northern Tool & Su pply Co. • *Foreign Representatives:* "COSMOS" Soc. in Nume Colectiv, Bucharest, Roumania. • *Direct Factory Representative,* Bucharest, Roumania • Industrial Agencies, Ltd., San Fernando, Trinidad, British West Indies • *Factory Representative,* Maracaibo, Venezuela • Mr. A. D. Bolland Avda. Pte. R. Saenz Pena 832, Buenos Aires, Argentina.

AXELSON
PLUNGER PUMPS
A TYPE FOR EVERY CONDITION



Aerial view of refinery at La Plata

above-mentioned refinery, which is situated near a power plant that consumes all the coke produced.

In the new combined unit at the San Lorenzo refinery, cracking is done in three stills; one reduces the viscosity, the second does the heavy gas-oil cracking, and the other cracks light gas oil by the Gyro steam process.

This plant is also equipped with a polymerization unit installed for the purpose of increasing the naphtha yield, and particularly for the purpose of increasing the octane grade of the naphtha.

The Argentine Republic, through an executive decree, has forbidden the use of leaded fuel in automobiles, and the use of lead is permitted only in aircraft fuels. The automobile naphtha sold, however, has an octane number of 66 to 69 and serves satisfactorily as a fuel.

In some refineries where the cracking process and the type of crude do not yield naphthas of the above grade directly, the heavy naphtha is reformed. One refinery employs a gas-oil cracking still for the reforming of naphtha, alternating its operation as conditions may demand.

Refineries equipped with cracking and viscosity reduction units that are treating Comodoro Rivadavia crude, and the San Lorenzo refinery, equipped with the combination unit described, do not have to reform the naphtha, as the quality of crude oils processed allows a direct production of naphtha of the required octane-grade for the market.

In the Y.P.F. refinery at La Plata, a combined unit is being installed, having a 1500 cu. m. (9430-bbl.) capacity. In the polymerization section of this unit, the gas produced in the entire plant will be treated; likewise in this plant will be treated quantities of butane and propane produced in the existing installations, when the market demand for liquefied gases may not require the latter products for the production of such gases.

Y.P.F. has a substantial market for the liquefied gases produced in an absorption plant installed in the La Plata refinery. This plant operates at a pressure of 350 lb. per sq. in. An additional plant has been installed in the new San Lorenzo refinery that will increase the volume of liquid gas produced, insuring a constant supply to the consumer in event any unforeseen circumstances should interrupt the manufacture of supergas (liquefied gas) in the La Plata refinery.

In the production of naphthas from Comodoro Rivadavia crude oil, which is treated to an intense cracking, their stability is insured, especially in cases of naphthas used in the northern part of the country, where the temperature is more than 38°C. (100°F.) during the summer, by treating them by the clay and inhibitor-addition process.

The naphthas sold in the Argentine must, by executive decree, be given a yellow coloring. These naphthas are sold by all authorized companies and have a 1.5 N.P.A. color.

In Argentina there is only one motor naphtha grade. Likewise it may be emphasized that there is only one price for naphtha throughout the country. A 5-cent tax per liter, payable by the companies, is included in the sales price.

Aircraft fuel having an octane rating as high as 82, is also produced in the Argentine. It is obtained by direct refining of processed crudes, adding thereto the necessary lead to impart the desired anti-knock rating.

For the purpose of supplying the increasing demand for 87-octane and higher naphtha, Y.P.F. is planning the installation of equipment for manufacturing isoöctane, for which the gas produced in the La Plata refinery will be used, in order to mix the product with straight-run and lead-base naphthas.

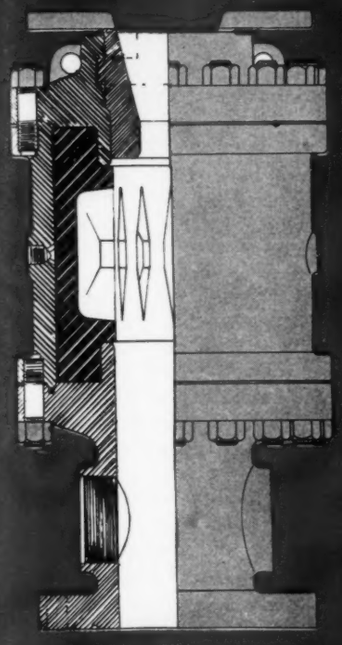
TABLE 2
Characteristics of Argentine Petroleums

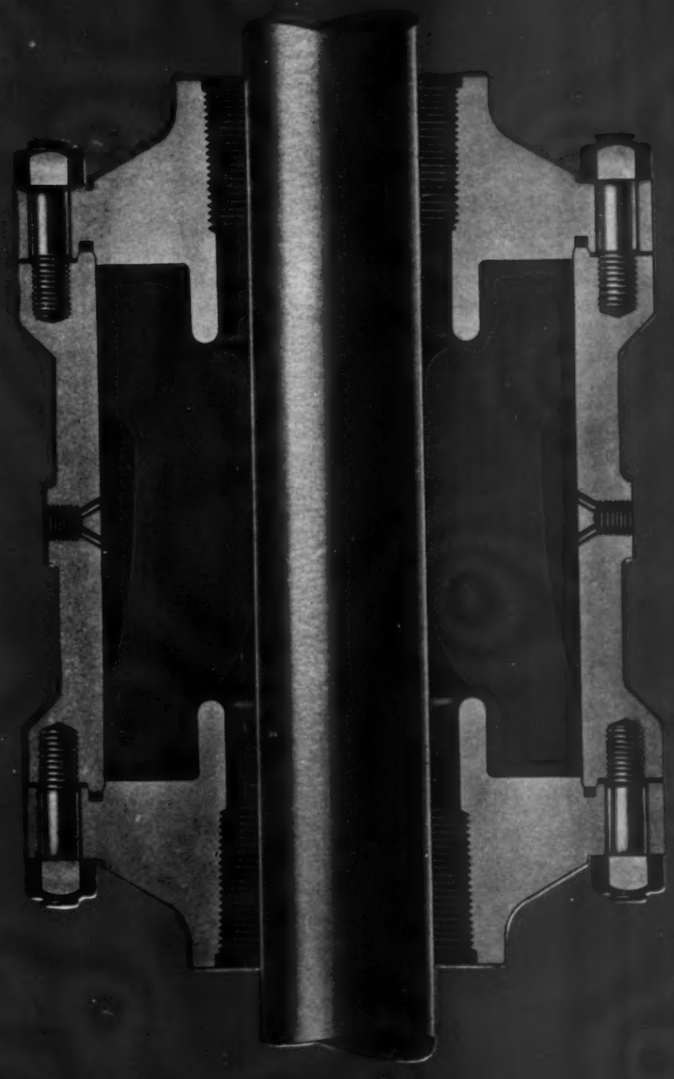
	Mendoza		Salta		Plaza Huincul		Comodoro Rivadavia	
	Tupungato	Cachetuta	Vespucio	Tranquitas	Middle zone	N. I. zone	Middle zone	Deep horison
Density* of crude oil	0.8651	0.8755	0.8059	0.8000	0.8682	0.8560	0.9160	0.8870
Naphtha—volume, percent	12.41	11.19	32.19	32.83	14.20	16.70	7.40	11.37
—density*	0.7225	0.7588	0.7350	0.7440	0.7507	0.7603	0.7428	0.7370
Kerosene—Volume, percent	12.00	11.87	24.76	26.32	16.10	16.50	5.05	12.84
—density*	0.7986	0.8069	0.7956	0.7940	0.7909	0.7980	0.8020	0.7900
Gas oil—volume, percent	12.70	14.03	17.50	15.28	20.40	8.90	12.35	7.90
—density*	0.8304	0.8305	0.8334	0.8320	0.8400	0.8518	0.8450	0.8330
Light lubricants—volume, percent	10.40	8.47	9.40	12.20	10.00	9.30	7.72	13.51
Medium lubricants—volume, percent	7.60	11.03	6.70	1.36	10.90	10.20	16.98	3.99
Heavy lubricants—volume, percent	.....	.....	.....	.....	11.00	6.90	14.23	7.86
Asphalt—volume, percent	.....	.....	.....	.....	18.50	12.10	33.73	42.04
Residue—volume, percent	44.59	43.41	9.45	11.58	.....	.....	.....	.....
Sulphur—weight, percent	0.18	0.12	.....	0.06	0.25	0.12	0.20	0.12
Freezing point	+27°C. / +81°F.	+27°C. / +81°F.	+15°C. / +59°F.	+15°C. / +59°F.	− 5°C. / +23°F.	− 5°C. / +23°F.	− 5°C. / +23°F.	− 5°C. / +23°F.

*Density at 15°C. (59°F.).

For Safety INSTALL A

REGAN TYPE K BLOWOUT PREVENTER





The operator can perform several important operations with the Regan Type K Blowout Preventer, such as running tubing, casing, or drill pipe under pressure, perforating or setting liners under pressure, and drilling under pressure. When equipped with a special packer, this Blowout Preventer can be used to effect a complete shut-off when the tools are out of the hole. As shown above, the Model 11-E positions the mud return line below the Blowout Preventer, while the Top Flange carries retaining bushings for high pressure operations. Designs to permit almost any desired hook-ups are available.

See Composite Catalog or write for complete details

Regan

Forge & Engineering Co.

San Pedro California

Quality – Wrought on the Forge of Experience

Mid-Continent Office
1502 Maury St., Houston

New York — 17 Battery
G. R. Woods, Rep.

Oklahoma and Kansas
Representatives
Bovaird Supply Co.
Tulsa and Wichita

Geophysical Prospecting in South America

All accepted geophysical methods are being employed in increased activity—Soil survey is attaining importance as a prospecting method

By W. R. RANSONE, Geophysical Service, Inc.

GEOPHYSICAL prospecting is not new in South America but never has there been a time when the activity in this phase of exploratory work has been greater.

As in other departments of the petroleum industry, South America was not far behind the United States in the adoption of geophysics as an aid in the finding of oil. Although geophysical parties were not unknown on either continent prior to 1928, that year is usually accepted as marking the true acceptance of geophysics by oil companies in South America.

Since 1928, geophysics has firmly established itself as a tool for the oil prospector as evidenced by the increase in the number of parties now in the field.

In South America, virtually all the various countries have witnessed some amount of geophysical exploration. At the present time, every accepted type of geophysical instrument is being used in the exploration work now being conducted. This includes the torsion balance (the earliest geophysical instrument to be used in the prospecting for oil), the magnetometer, the gravity meter, both reflection and refraction seismographs, and the most recent addition to the family of geophysical methods—the soil survey involving a geochemical analysis of the soil in or near the surface of the earth.

Accurate data on the number of parties in the field using certain of these instruments at the present time are not available. The number of parties now active, employing the seismograph—the instrument with which the writer is most conversant—may be listed as follows:

Parties operating in:	*No. of parties*
Venezuela	10
Colombia	9
Trinidad	2
Argentina	2
British Guiana	1 or 2
Total	24 or 25

Immense Virgin Territory Explains the Methods Employed

Those in the United States who are interested in learning more of geophysical activity in South America usually ask the two following questions, among others: (1) why does it seem that geophysics is used so extensively in South America? and (2) why are so many different types of instruments used simultaneously? Following the latter question is usually the comment that because certain instruments have been used less frequently in recent years in this country (the United States) surely the more popular ones might reasonably be used in South America to the exclusion of the others.

Answering the second of these questions first, a discussion of the relative merits of geophysical methods is a highly controversial one that need not be entered into here. Not so much in a spirit of fairness as in a plain statement of fact, all types of instruments and methods are finding use in South America because the potential territory to be surveyed is so large and so little relatively is known of the subsurface geology of the continent. This pioneer aspect of the region requires prospecting with all types of geophysical instruments, frequently using the lower cost methods first in order to obtain some information in the large areas under consideration before going ahead with the costlier and more effective methods. Furthermore, the structural conditions encountered are as varied in type as those in other parts of the world and opportunity is presented for applying the method best suited to the particular problem.

W. R. RANSONE

was born in Cleburne, Texas, September 5, 1908—Obtained degrees at Southern Methodist University and the University of Texas, in mathematics and physics—Employed from 1926 to 1930 by Geophysical Research Corporation during school vacation periods—Employed by Geophysical Service, Inc., from 1930 to present time—Has been supervisor in charge of the company's operations in South America since 1936—Has specialized in foreign work, his activities embracing Canada, Panama, Colombia, and Venezuela—At present is in the home office of the Geophysical Service, Inc., Dallas, Texas.

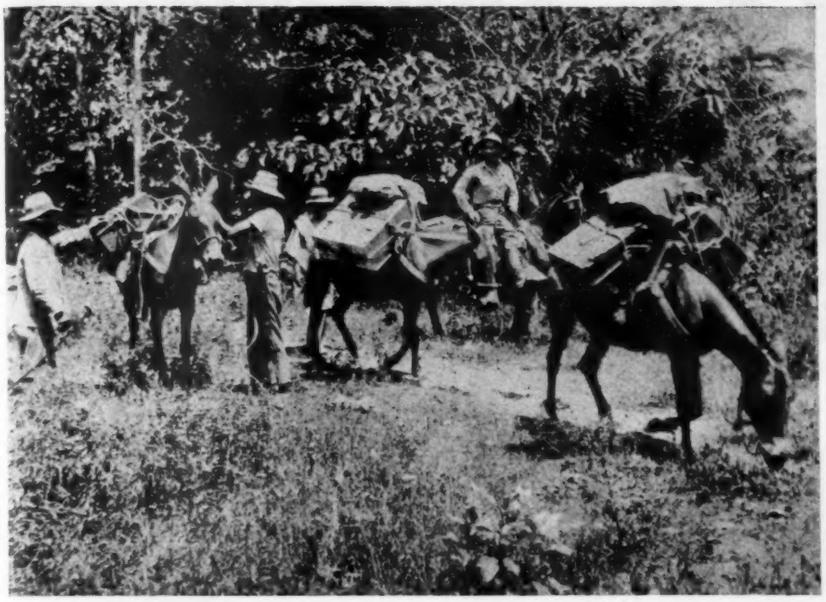
Answering the first question: it can be said definitely that geophysics is a very important aid to the prospector for oil in South America simply because it is virtually the only means of learning the subsurface structural conditions in many areas. In Venezuela and, to a great extent, in Colombia, studies of surface geology as an approach to a knowledge of subsurface structures are rendered almost valueless because of the blanket of recent sedimentary material that covers the region. Varying from a few ft. to 200-300 ft. in thickness, these deposits of Pleistocene sands and gravels effectively obscure all evidence of earlier geologic history. Thus is increased the dependence that must be placed in geophysical methods as the only means of obtaining the desired information.

Refraction Seismograph Is Being Used

Coming as a surprise to many is the fact that the refraction seismograph is being used extensively in South America at the present time. At a time when the refraction method has been almost entirely supplanted by the reflection seismograph in the United States, this may seem unusual.

Its use may best be explained by comparing South America, from a geophysical standpoint, with the United States of 10 or 15 years ago.

At that time, when only a comparatively small portion of the area now surveyed geophysically had been covered, the refraction seismograph was being used to great extent in various parts of this country. Its popularity at the time nor its subsequent



Compact, lightweight equipment must be transported on mule-back in many parts of South America

decline in use were neither due to just an evanescent interest on the part of geophysicists. It served a definite purpose during the pioneering of geophysical prospecting in the United States, a comparable service that is now being rendered in South America.

Major Anomalies Only Are Sought

Even though, as pointed out, geophysical surveying is not new in South America, the tremendous area yet to be mapped contributes to still another practice that may seem unusual to those conversant with present-day geophysical work in the United States.

In the oil areas of the latter country, particularly in the Gulf Coast region, geophysical parties, having apparently located and defined most of the major structures, are now concentrating upon minor anomalies, exhausting every possibility, virtually combing the earth to discover every slightest evidence of subsurface conditions favorable to the accumulation of oil.

In South America, at the present time, following the same logical procedure, neither the geophysicists nor the oil companies retaining them are interested, usually, in more than a definition of the broader, more extensive subsurface features and the anomalies that are indicative of the possible presence of oil. Perhaps to the uninitiated, it might appear more efficient and less expensive in the long run to exhaust all possibilities in a "once-over" of the country, particularly in view of the difficulty of gaining access to the more remote parts of the regions surveyed. To obtain the data prerequisite to a detailed survey, however, requires much more time and consequent expense so that the present method is probably the more economical in most instances.

Soil Surveys Being Made

Those who are following the development of the comparatively new method of locating oil by geochemical analyses of the soil at the earth's surface will be interested in the information that several soil surveys have been made in South America and have shown encouraging results. The present interest in this method indicates that it is attaining importance as a prospecting method for both reconnaissance and detailed surveys.

Transportation a Problem

So much has been written about the difficulties of moving men and equipment in the interior regions of South America that little comment will be made here.

In seismic surveys, as in surveys made by nearly all other types of geophysical instruments, the party must be equipped for every emergency that can be foreseen. Modern equipment has been made more rugged even as it has been reduced in weight by use of alloyed metals when possible. Special instruments, modified, compact models of the kind used in open country, have been developed to facilitate transportation by mule-back or in small boats. Trucks are used, of course, when the topography of the area permits.

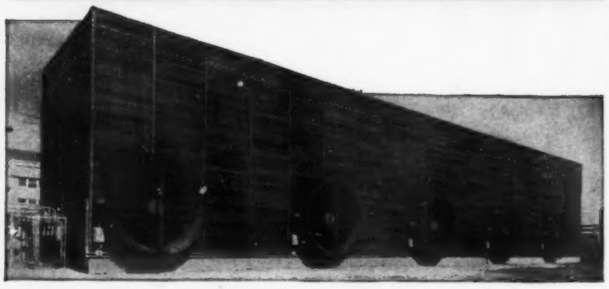
Transportation will continue to account for the major part of the expense in conducting geophysical work in South America for several years to come. Even with the present development of a few main highways and of others certain to be built as the oil activity increases, it will still be years, if at all, before a lateral road system may be built that will materially benefit the geophysical parties who, necessarily, must always be penetrating into remote areas far in advance of the development that accompanies the finding of oil.

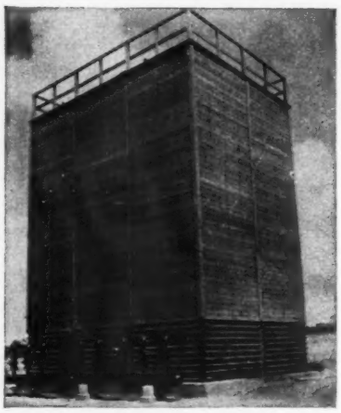
Surveying by seismograph on the bank of the Magdalena River

PROTECT

AGAINST THE DANGERS AND EXPENSE OF IMPROPER COOLING WATER TEMPERATURES

WITH A **MARLEY** MECHANICAL DRAFT **COOLING TOWER**





Wide experience solving water cooling problems for plants large and small in all types of industries—plus the completeness and standardization of the Marley line—enable Marley's veteran engineers to furnish for each individual installation, equipment most efficient and economical for the service. It will pay YOU to consult the pioneer and leader . . . MARLEY!

INFORM YOURSELF FREE on this subject so important to sound, economical plant operation by mailing this coupon today.

Send big attractive new booklets fully illustrating and describing advantages, applications and features of mechanical draft water cooling equipment.

NAME.....

COMPANY.....

STREET NO.....

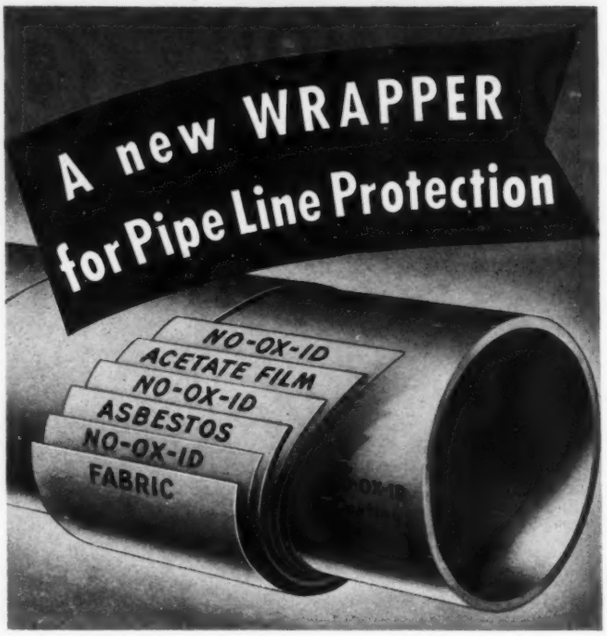
CITY..... STATE.....

The MARLEY Company

Fairfax and Marley Roads, Kansas City, Kansas

Sales Offices or Agents in Principal Cities

ANNOUNCING



NO-OX-IDized Reinforced Asbestos Wrapper

Here is a new wrapper that provides greatly increased pipe line protection. Yet it remains pliable enough to cover irregular surfaces without cracking.

Like the well-known NO-OX-IDized Asbestos Wrapper, this new wrapper has a heavy asbestos layer impregnated with NO-OX-ID. In addition, it is reinforced with a light fabric and a layer of acetate membrane covered on both sides with NO-OX-ID. As a result, this new wrapper has vastly greater moisture resistance, dielectric strength, and tensile strength. It is used in conjunction with regular NO-OX-ID coatings, for hot or cold hand application or for machine application. Dearborn Chemical Company, Dept. L, 310 S. Michigan Ave., Chicago.

- **Moisture-Proof**
- **100% More Tensile Strength**
- **100% More Dielectric Strength**
- **No Pin Holes**
- **Will Not Crack**
- **Resists Soil Action**
- **Impervious to Fungus**

NO-OX-ID

IRON-OX-RUST

TRADE MARK

The Original Rust Preventive

Isolated Fields of Colombia Necessitate Adequate Maintenance Facilities

Complete machine shops and foundry are operated to repair and maintain equipment in all departments

By

H. W. PALKOWSKY, Petroleum Engineer
International Petroleum Company, Toronto, Canada

and

R. V. WELCH, Metallurgist
Tropical Oil Company, El Centro, Colombia

THE relative importance maintenance of equipment assumes in some of the South American oil fields may be readily appreciated by considering the problems that confront an operator in remote areas. Despite the diversity of problems, they practically all arise from one or a combination of the following factors:

(1) Distance from source of supplies
(2) Scope of operations
(3) Climatic conditions

Distance when used for purposes of comparison is meaningless unless defined in terms of transportation time. In the case of the De Mares concession in Colombia, operated by the Tropical Oil Company, the center of operations is approximately 500 kilometer (311 miles) from the Caribbean seaboard. Although this distance may not appear to be extreme, it must be traversed almost entirely by means of river boat except for a short rail haul at each end of the route. Transportation on the Magdalena River involves most of the uncertainties and difficulties encountered in river traffic, such as alternate periods of high and low water and shifting currents and channels. In addition, there are three trans-shipments of the cargo from the ocean vessel to its destination at the field warehouse. On routine orders it requires 3 to 4 months' time from the date of local requisition for delivery of material and supplies from plants situated in North America. This element of time, then, is a highly important factor from the field man's standpoint, as the problem of replacements must be met either by carrying adequate warehouse stocks or the maintenance of repair facilities in the field. Both methods must be relied upon, although the latter is by far the more economical.

The scope of operations in any field has a direct bearing on maintenance problems because of the variety of equipment that must be serviced and repaired. In addition to all the activities directly connected with drilling for and producing oil, the Tropical Oil Company must, of necessity, install and operate its own transportation system to and within the field. This involves river boats, a railroad from the river port to the field, and about 500 kilometers (311 miles) of roads within the oil field proper. Obviously, equipment and materials are standardized as much as possible although a standardization policy can only be applied to definite lines of operation and therefore cannot solve the entire problem. It has also been found that standardization of machinery has definite limitations from a maintenance standpoint because manufacturers from time to time alter the details of their machines to such an extent that many of the parts are not interchangeable and after a time are not replaceable.

The field, situated as it is, has all the disadvantages of a tropical climate. The annual rainfall is usually around 120 in. although in extreme cases it may be as great as 197 in. The soil formation is predominantly loose and unconsolidated and consequently is readily subject to slides and the effect of such an excessive amount of rainfall on general road conditions may be imagined. The result is that a complete line of road maintenance equipment must be continually operated and maintained in the field.

Because of the severe operating conditions in this field and its isolation from the source of supplies, it behooves the company to use every resource in prolonging the life of equipment not only through efficient upkeep but also through constant improvement in repair methods as well as in the use of second-hand materials. Speaking of oil fields generally, it may be said that in no other phase of oil-field work is there so much opportunity for new and constructive ideas as in the mechanical division. It is also probably true that this department contributes the greatest number of improvements to oil-field equipment used by the industry as a whole.

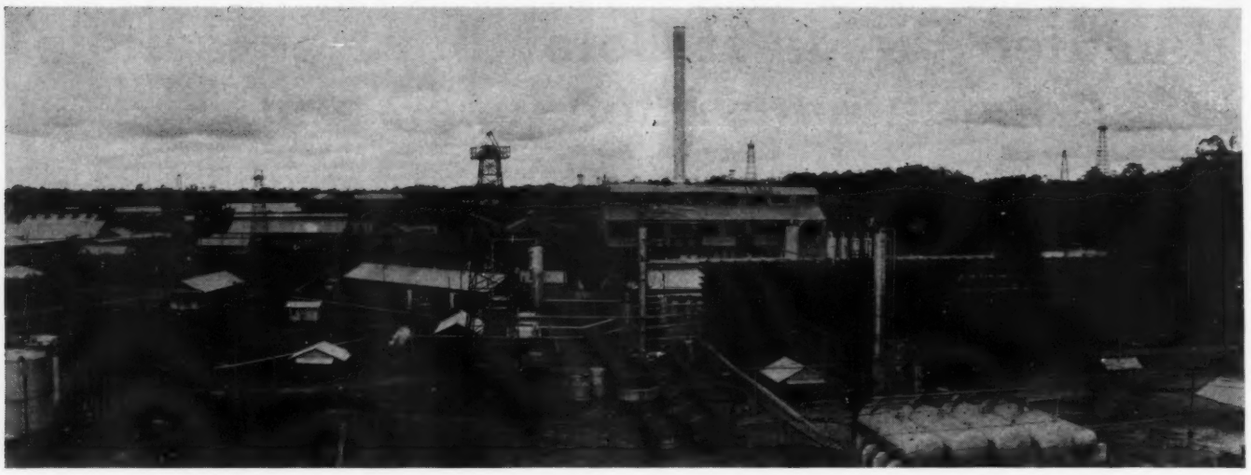
Shop Facilities and Methods

Of all the service departments in the De Mares field such as electrical, automotive, construction, etc., the machine shop with its various subdivisions has the greatest variety of materials and equipment. To cope with general maintenance and to meet successfully any emergency repair jobs that may arise, the prime requisites are wide experience and ingenuity on the part of the personnel. Next in order of importance is flexibility in shop equipment and

THE AUTHORS

H. W. PALKOWSKY is a graduate in chemical engineering from the University of Kansas—As his initial connection with the petroleum industry he spent four years in the Mid-Continent fields, two years in natural gasoline work, and two years with the Standard Oil Company of Louisiana, in Arkansas and Louisiana—He was in Peru, South America, with the International Petroleum Company for three years and in Colombia with the Tropical Oil Company for ten years—At the present time he is a petroleum engineer with the International Petroleum Company and has his headquarters at Toronto, Canada.

R. V. WELCH is a graduate in chemical engineering from the University of Toronto—His first business experience was with the Steel Company of Canada, Hamilton, Canada, followed by work as an analyst for the British American Oil Company, Toronto, Canada—The last three years he has been a metallurgist with the Tropical Oil Company, having his headquarters at El Centro, Colombia.



A part of the industrial center of El Centro, Colombia

methods. To meet this latter requirement it is necessary to have complete facilities for welding, forging, and foundry work. Likewise, within the machine shop proper, equipment capable of performing a wide scope of machining operations should be selected. Machines in the El Centro shop include the following:

1. For turning and general lathe work: turret, engine, bench, and vertical-turret lathes, and boring-mill.
2. Planers and shapers.
3. Heavy-duty milling machines.
4. Slotting: stroke slotter and small key seater.
5. Drilling: radial drill press and pin drill.
6. Boring: portable boring bars.
7. Tool grinders.
8. Power saws.
9. Pipe work: machines for threading, cutting, and slotting.
10. Hydraulic press.

All these machines are driven by individual electric motors.

Reconditioning of equipment used in drilling and production and in gasoline plants constitutes an important phase of service for the machine shop. This work includes general repairs to pumps, engines, and hoists, re-babbitting and boring bearings and bushings, and repair of production and drilling tools.

Probably the greatest demand from an output standpoint is in the repair of cylinder parts. In addition to the equipment in five natural gasoline plants there is a large miscellaneous variety of engines and pumps in the field whose maintenance constitutes a vast amount of piston, ring, and liner replacement. The types and sizes of this equipment are so varied that it has been found desirable to cast and machine these parts locally, except for piston rings of large size, such as 16 in.; these are obtained from manufacturers. The pistons and rings are lathe-turned and likewise the boring of small cylinder liners is done in a lathe.

A method for handling large liners has been devised that permits the use of general shop equipment and obviates the necessity of installing special machines for one type of work only. A 16-in. liner, for example, is first rough-turned in a lathe and then pressed into place with a hydraulic press. Next it is bored to size by means of a portable boring bar driven by a converted air-drill motor fixed in a permanent jig. The cylinder and liner are then placed on the bed of a large planer and a shaft, to which hones are attached by adjustable spring devices, passes through the cylinder and is fastened by means of a thrust bearing to the planer crosshead. As the planer bed moves backward and forward, the shaft carrying the hones is rotated at the desired speed by another converted air-drill motor. This locally-adapted apparatus is easy to set up, works rapidly, and gives the cylinder a true inside bore with a mirror-like finish.

Welding

Welding plays a very important part in repair work. The electric arc is used for practically all types of work, the necessary current at the shop being supplied by stationary welding generators. For outside work, such as steel construction, repairs to pumping equipment, pipe lines, and tank building, truck-mounted machines are used.

Propane is used for most of the cutting and is delivered to the shop through a 1½-in. line directly from the El Centro gasoline plant. This product is also bottled for field use. Natural gas is also used to some extent for cutting and is found to work almost as well as propane except for a slower start in cutting. Both the electric arc and acetylene are employed in cast-iron repair work. Preheating and stress relief are performed in knock-down, gas-fired furnaces that may be quickly set up to accommodate the individual job.

Electric bronze welding is used when cast iron is not feasible and provided machining difficulties do not interfere. This method has frequently been found to save much time in the repair of damaged equipment as the following example will illustrate. A cast-iron oil pan constructed integrally with the engine bed of a crane unit was shattered into a number of small pieces. Fortunately all the pieces were recovered and it was possible to weld them together and the whole reinforced by a steel plate welded underneath the pan so that the unit was ready for service within 5 hours. By resorting to this method the necessity of dismantling and reassembling the unit was eliminated; the processes of preheating and stress relief after welding were also obviated.

An important function of the welding shop is building-up of worn parts. Items like kelly bushings, catheads, road-grader blades, shafts, and piston rods are built-up with the electric arc. In addition to the arc, a metal spray gun is now being used with considerable success on worn shafting and piston rods.

Hard-facing finds extensive application, the tungsten carbide rod being used in large quantities on ripper teeth, grader blades, and various other pieces of soil-moving machinery. The life of caterpillar tracks has been considerably increased by applying a thin layer of hard-facing metal to the lugs. In some instances gas-engine exhaust valves are stellited.

Welding is used extensively in pipe-line work, both high-pressure and low-

pressure. Economies are effected by welding all headers, low-pressure bull plugs, and miscellaneous connections.

All drilling equipment has been rebuilt and remodeled within the last few years. Drawworks have been unitized, slush pumps and boiler feed pumps skid-mounted, and steam engines mounted on steel substructures. Study of drilling-bit performance, an extremely important phase of shop service for a number of years, has contributed remarkably to footage results.

In conjunction with the welding division, there is a boiler shop for the reconditioning of drilling, locomotive, and various other boilers used in the field. Equipment in this shop consists chiefly of 12-ft., 13-in. diameter plate rolls, a punch and shear machine, and a drill press and press brake. This machinery is also used in tank construction and various other steel fabrication. Hydrostatic testing facilities are available for all pressure-vessel work.

Forging and Heat Treatment

A highly useful division of the mechanical department is the forge shop. There are three steam hammers of 3400-lb., 1000-lb. and 600-lb. capacity, respectively, and a bolt-heading machine, and a rock-drill sharpener. Three large gas-fired forge furnaces and three smaller ones for hand-forge work supply the heating requirements. Steel stock for the forge shop is generally imported in round sections ranging from 6- to 12-in. diameter, from which large casingheads, slips, shafts, axles, and miscellaneous small articles such as chisels, etc., are made as routine production. All pipe-line tools are also regularly maintained by this shop.

Heat-treating is done in a 1600-lb. capacity pyrometer-controlled gas-fired furnace conveniently situated to quenching tanks and a lead-tempering bath. Cyanide is used for all surface hardening of such articles as casing-head slips and rings. The ease of handling this method makes it more suitable to the types of case-hardened articles involved than any other method yet tried by the company.

Reclamation of Materials

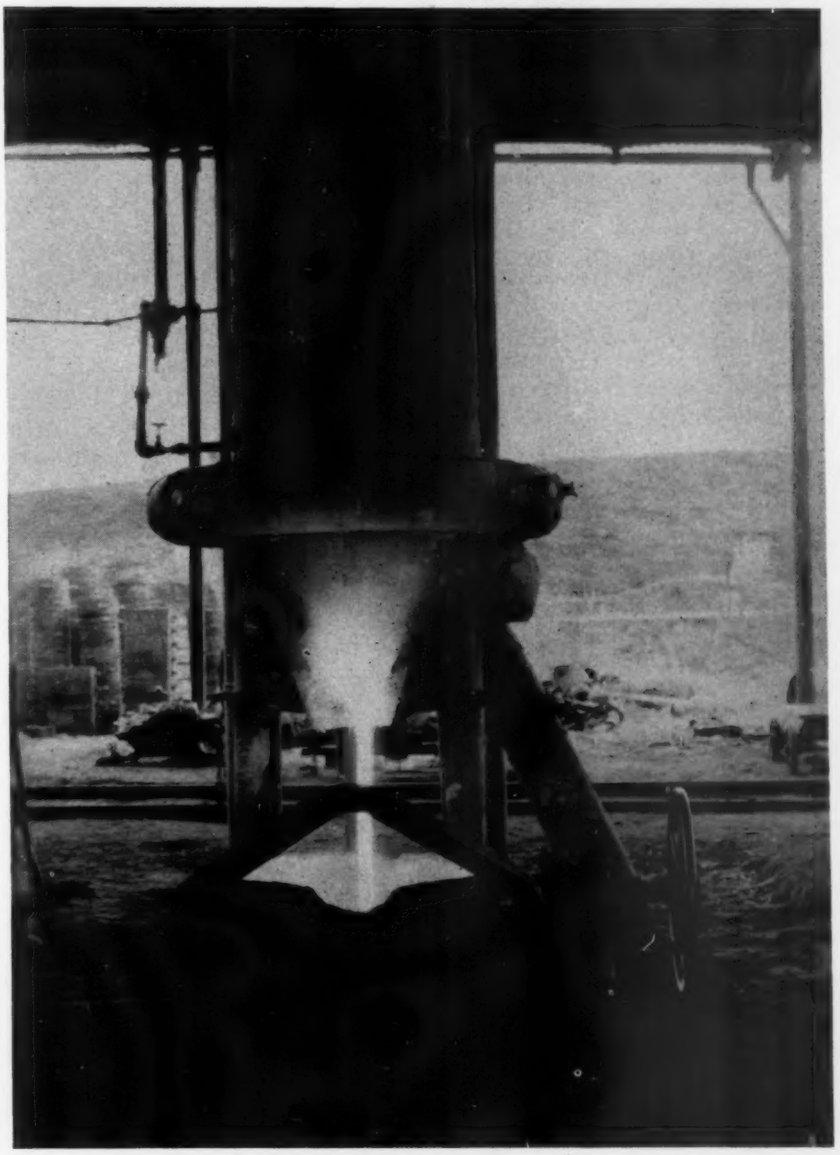
The salvage of used and obsolete material and its subsequent utilization for various needs is an important and unique phase of Tropical Oil Company's operating methods. This particular department lends itself to close coördination with the general program of field maintenance.

In any field of considerable size there is a vast assortment of damaged, obsolete, and otherwise worn-out equipment and material that constantly finds its way to the reclamation yard. This material is classified and segregated according to its value for further application. A considerable portion of the material such as dismantled valves and fittings and miscellaneous hand tools are reconditioned with new spare parts and reissued as second-hand stock for the original purpose intended.

The various classes of tubular goods including sucker rods comprise the chief replacements because of wear and therefore in turn constitute the chief source of material for reclamation. Actually, every portion of worn pipe finds almost immediate application. Used tubing and drill pipe in considerable quantity are converted to line-pipe use with practically no waste. In the case of tubing, the upset ends are cut off and made into combination nipples and the rest of the pipe rethreaded with line pipe threads.

Another important general use of scrapped pipe is in the substitution for structural steel. Steel for the construction of high-tension power lines, service lines, and transformer stations is supplied from reclaimed pipe. Discarded boiler tubes, due to their light weight and rigidity, are used in the fabrication of small buildings such as engine and pump houses. Even casing and tubing thread protectors are utilized. The former by means of welding are used in constructing triangular pipe-line supports and also make suitable flasks in foundry work. Tubing thread protectors serve in the foundry as risers and gates in casting.

Worn sucker rods are used as reinforcing steel. The high tensile strength of this material makes it useful for making tie rods and braces. Incidental



Tapping cupola heat in the El Centro foundry

uses are the manufacture of drift pins, anchor bolts, ladders, and even outdoor benches.

Foundry and Metallurgical Practice

Due to the extensive use of foundry products, the company has found it desirable to place this phase of work under metallurgical control along with that of drilling-bit service and other technical processes pertaining to the working of metals.

When an obsolete machine or a broken-down piece of equipment is dismantled such parts as shafting, gears, nuts, bolts, and springs are salvaged first. The remainder of the material is then further segregated according to the class of metal for foundry needs. Steels are cut into suitable size pieces by propane torches; an electrically-operated drop-ball hoist is used to break-up cast iron. The process of segregation is facilitated by classification according to iron- and steel-composition ascertained from manufacturers' specifications. As the compositions of brasses and bronzes vary so widely, it has been found more feasible to make-up this material into ingots for remelting, each cast being analyzed before use. The almost unlimited variety of metals salvaged provides excellent raw material for a foundry.

The plant equipment consists of a 30-in. cupola, a 500-lb. acid-lined electric furnace and a 500-lb. horizontal gas-fired furnace for non-ferrous metals. Coke for the cupola and sand for steel castings must be imported; suitable sand for iron and non-ferrous work is obtained locally. Patterns are usually made from local mahogany although those most frequently used are now being made of aluminum because of the effect of the humid atmosphere on wood.

Because of the large preponderance of steel scrap available, steel is used in casting in the maximum amount that will still permit the products to have desired properties. Alloys used for both iron and steel, in addition to the usual silicon and manganese, are nickel, chromium, and copper. Silicon and manganese of pea-size are first molded into briquets having a portland cement binder and these are added to the cupola charge. In this way, there is very little loss of the alloys. Desulphurizing treatment has not been found necessary thus far although sodium carbonate has been used in the ladle in a sufficient number of instances to establish a procedure in case of need.

Whenever possible the electric furnace is used for both iron and steel and occasionally for bronze. Heats average 850 lb. and current consumption about 0.4 kw-hr. per lb. of metal. In the case of the larger iron castings, it is sometimes necessary to resort to duplexing cupola iron in the electric furnace to maintain casting temperatures. Steel melting is controlled by carbon and manganese snap analyses. Slag composition is closely followed by FeO analysis and it has been found possible to increase residual manganese by almost 50 percent by paying close attention to amounts and times of lime additions based thereon. All tapping and pouring temperatures are checked with an optical pyrometer.

Bronze and aluminum are the principal non-ferrous metals cast although copper and lead articles are made from time to time. Three types of babbitt-metal and five types of bronze bearings are required to fill all bearing requirements. Two different compositions of valve metal are cast for making valve parts. Aluminum castings are used chiefly in the manufacture of pistons, sheaves, and baffle plates used in cementing. Auxiliary equipment in the foundry consists of grinders, sand-blasting equipment, etc. For cutting risers, torches are equipped with spe-

Through the Grizzly Rotary Brake Block Band Exchange, *users* are supplied with Grizzly Full-Moulded Rotary Brake Blocks *factory installed* on bands for *your* particular type of drawworks—in exchange for old ones. It is a time, labor and money saver, eliminating all the difficulties of field installation. *Users* are assured of the correct lining for each job; perfect fit; and fast, easy installation *at no extra cost.* Carried in stock by *your* supply dealer, ready for immediate delivery to *your* rig. Ask any leading supply company or Grizzly branch for details.

E. M. SMITH COMPANY
600-650 South Clarence St., Los Angeles, California, U.S.A.
Complete Stocks Maintained in Our Warehouses At: 1121 Rothwell St., Section 16, Houston, Texas. 1008 S. E. 29th St., Oklahoma City, Okla. *Export Office:* Continental Emsco Co., 30 Rockefeller Plaza, New York City.
DISTRIBUTED BY LEADING SUPPLY COMPANIES

cial tips for use with either propane or natural gas. All iron castings are stress-relieved and steel castings annealed in the heat-treating furnace before machining. It may be of interest to state that originally the foundry was intended for emergency work only, whereas at the present time this plant supplies all the castings required on the Concession.

This article has dealt only with maintenance of equipment, only one phase of the general problem. Examples of other types of maintenance for which the Tropical Oil Company has developed specific methods of procedure are in equipment used to build and maintain roads, buildings, and pipe lines.

Training of Colombian Personnel

Personnel training in a foreign country is more important than operators in America may realize. To understand this problem, it must be borne in mind that large areas of Colombia are still undeveloped in population as well as in transportation and industry. The chief means of livelihood is agriculture and this occupation is confined to the more habitable areas. Due to the inhospitable climate, even agriculture fails to thrive in the Magdalena Valley and, as a result, population has always been very sparse in this region. When the development of the De Mares concession began, the Tropical Oil Company was faced not only by a complete lack of experienced oil-field personnel, but likewise by a limited supply of stable, dependable workmen. In these circumstances, the company was compelled to obtain all its skilled mechanics and operators from the United States. For a number of years these men performed all the mechanical operations in connection with the various shops and field work. Later the company adopted the policy of training Colombian workmen to do many of the tasks for which foreigners had to be employed originally.

Because of the centralization of operations and the close supervision maintained in the various shops, experience has shown that the following system is particularly well adapted to this class of work. In developing prospective machinists, young men from 17 to 22 years of age are first selected as it has been found that the aptitude for learning decreases perceptibly after this period of age is passed. On first entering the shop, the young man for the first few weeks is allowed to accustom himself to the surroundings by acting as an all-around helper. After the prospect has had an opportunity to observe general shop routine he is placed as a helper on some particular machine. He remains in this status for approximately two years. During this time he will have worked on all similar machines in the shop, thus learning about the care and operation of lathes and drill presses. Toward the end of the helper period, he will also have become conversant with the different types of work performed by special machines. When the man is able to interpret a comparatively simple blue print, he is allowed to do roughing jobs with gradually increasing requirements as to accuracy.

Upon demonstrating that he has a knowledge of the various types of work in which he has been instructed, the man is then assigned to operate a certain machine and is classed as a competent machinist. If a man shows exceptional ability and initiative, he is given an opportunity to acquire experience in operating different types of machines. When he becomes capable of operating various machines in the shop he is promoted to the status of first-class machinist.

LOOK WHAT HAPPENS WHEN PUMP PRESSURE GOES TOO HIGH . . . . . .

That's how your costly pump parts and rotary hose are automatically protected by this world famous valve.

It's as simple as that . . . yet it gives your pump and parts the best protection available against damage resulting from otherwise hazardous pressures. It is easily reset by any member of your crew, and your only repair parts are common nails. No wonder operators all over the world swear by the Shear-Relief Valve.

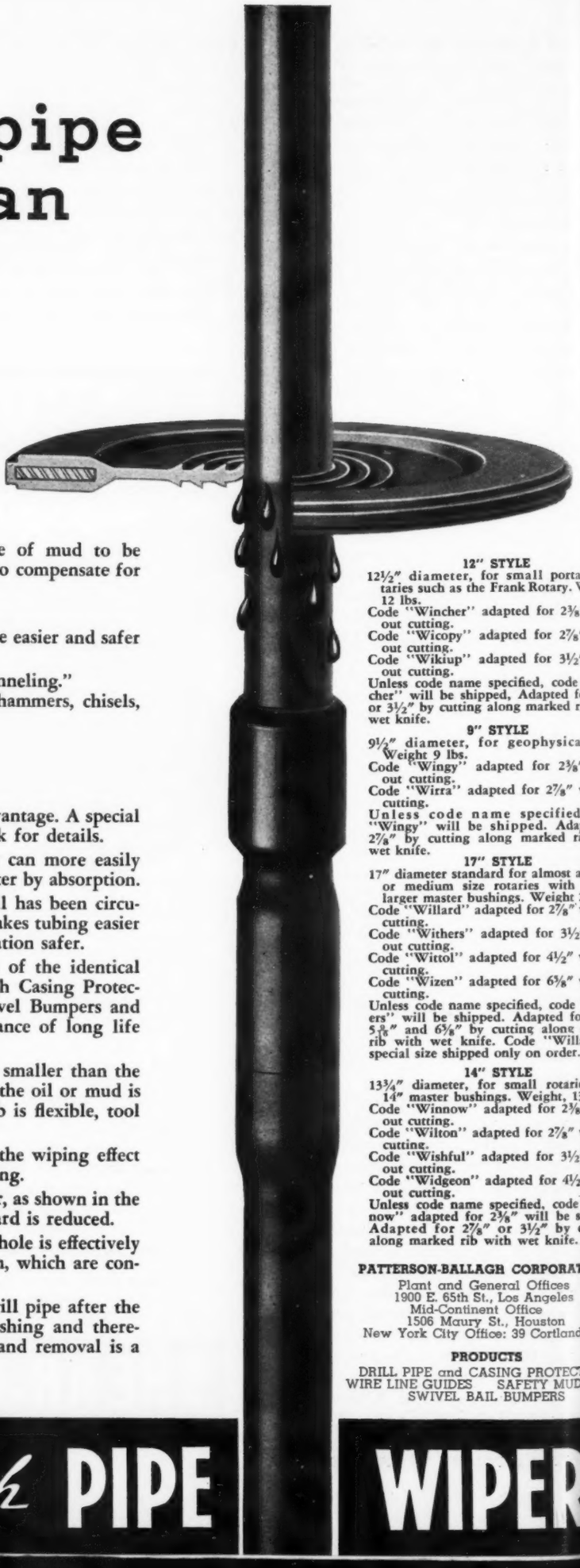
Full details in your Composite Catalog.

FLUID-PISTON HIGH PUMPS
ABERCROMBIE PUMP CO.
GULF BLDG. HOUSTON TEX.

SHEAR-RELIEF VALVE

Keep your pipe wiped clean

Patterson-Ballagh Pipe Wiper makes the pulling of tubing safer and less disagreeable. Wipes either oil or mud without change. Simply insert beneath spider. No attachments needed. Absolutely sparkproof. A one-piece reinforced disc of seamless rubber with a flexible web. The drill pipe being pulled through web is effectively wiped free from mud. NO WASH WATER REQUIRED.



ADVANTAGES

Wipes mud and weight material, reducing volume of mud to be handled, as no mud weight material need be added to compensate for wash water added.

Saves water.

Rig is safer as floor is not as wet or muddy. Drill pipe easier and safer to handle.

Mud not being diluted to blowout point, no "channeling."

As hole is covered, loss of broken slips, tong dies, hammers, chisels, etc., into the well greatly reduced.

Ice hazard greatly reduced in freezing weather.

As no metal exposed sparking hazard is reduced.

Application and removal a matter of minutes.

For geophysical rigs the saving in water is a great advantage. A special small diameter wiper is available for this service. Ask for details.

As there is no dilution, the Geological Department can more easily and accurately determine the porosity and loss of water by absorption.

Strips oil from tubing and from drill pipe where oil has been circulated, reducing cuts and infection on men's hands. Makes tubing easier to inspect. Reduces oil on rig floor, making rig operation safer.

The rubber from which this Wiper is fabricated is of the identical quality used in the manufacture of Patterson-Ballagh Casing Protectors, Open Hole Stabilizers, Wire Line Guides, Swivel Bumpers and Rubber-Lined Nozzles; therefore, there is the assurance of long life and satisfactory service.

The hole in the center of the Pipe Wiper is slightly smaller than the diameter of the pipe. There is no break in the web, the oil or mud is effectively "squeegeed" from the surface. As the web is flexible, tool joints and Protectors pass through easily.

The inside edge of the Wiper is beaded, increasing the wiping effect —increasing its life and decreasing danger from tearing.

A flat metal disc is fabricated wholly inside the Wiper, as shown in the cut. No metal whatever is exposed; thus the fire hazard is reduced.

As the disc is in one piece and of large diameter, the hole is effectively protected against the dropping of small items therein, which are constant fishing hazards.

Pipe Wiper is installed by being slipped over the drill pipe after the Kelly is removed; is pushed beneath the master bushing and thereafter floats freely on the drill pipe. Its installation and removal is a matter of minutes.

12" STYLE

12½" diameter, for small portable rotaries such as the Frank Rotary. Weight, 12 lbs.
Code "Wincher" adapted for 2⅜" without cutting.
Code "Wicopy" adapted for 2⅞" without cutting.
Code "Wikiup" adapted for 3½" without cutting.
Unless code name specified, code "Wincher" will be shipped, Adapted for 2⅞" or 3½" by cutting along marked rib with wet knife.

9" STYLE

9½" diameter, for geophysical rigs. Weight 9 lbs.
Code "Wingy" adapted for 2⅜" without cutting.
Code "Wirra" adapted for 2⅞" without cutting.
Unless code name specified, code "Wingy" will be shipped. Adapted to 2⅞" by cutting along marked rib with wet knife.

17" STYLE

17" diameter standard for almost all large or medium size rotaries with 17" or larger master bushings. Weight 21 lbs.
Code "Willard" adapted for 2⅞" without cutting.
Code "Withers" adapted for 3½" without cutting.
Code "Wittol" adapted for 4½" without cutting.
Code "Wizen" adapted for 6⅝" without cutting.
Unless code name specified, code "Withers" will be shipped. Adapted for 4½", 5⅝" and 6⅝" by cutting along marked rib with wet knife. Code "Willard" is special size shipped only on order.

14" STYLE

13¾" diameter, for small rotaries with 14" master bushings. Weight, 13 lbs.
Code "Winnow" adapted for 2⅜" without cutting.
Code "Wilton" adapted for 2⅞" without cutting.
Code "Wishful" adapted for 3½" without cutting.
Code "Widgeon" adapted for 4½" without cutting.
Unless code name specified, code "Winnow" adapted for 2⅜" will be shipped. Adapted for 2⅞" or 3½" by cutting along marked rib with wet knife.

PATTERSON-BALLAGH CORPORATION
Plant and General Offices
1900 E. 65th St., Los Angeles
Mid-Continent Office
1506 Maury St., Houston
New York City Office: 39 Cortlandt St.

PRODUCTS

DRILL PIPE and CASING PROTECTORS
WIRE LINE GUIDES SAFETY MUD GUNS
SWIVEL BAIL BUMPERS

Patterson-Ballagh **PIPE WIPER**

Polymerization of Hydrocarbons Present in Natural Gas

A PETROLEUM ENGINEER EXCLUSIVE FEATURE

The many polymerization processes perfected in the last few years permit a close selection to conform to local requirements

By RAFAEL FUSSTEIG

ONE source of raw material for polymerization is natural gas. The pyrolysis of gaseous paraffinic hydrocarbons has been investigated from various viewpoints by many investigators. The conversion of gaseous paraffins into liquid polymerization products take place in two steps. By using proper temperatures and contact times, the pyrolysis and the polymerization can be conducted as separate operations, or combined.

Natural gas contains about 75 percent methane, the rest being ethane, propane, butane, etc. The first step of the above-mentioned process is to dehydrogenate these gaseous compounds to form gaseous unsaturates. The hydrogen may then be easily substituted in the polymerization reactions, where the lack of hydrogen causes the formation of tar and coke. In the opinion of the writer, the following reactions should occur during the decomposition of saturated hydrocarbons, resulting in the delivery of nascent hydrogen:

$$CH_4 \rightarrow =CH_2 + 2H$$
$$C_2H_6 \rightarrow 2=CH_2 + 2H$$
$$C_3H_8 \rightarrow 3CH_2 + 2H, \text{ etc.}$$

These $=CH_2$ molecules are then polymerized into unsaturated gaseous hydrocarbons, which may be considered as the material for production of liquid gasoline-like hydrocarbons. Each of the components of natural gas, however, requires specific operating conditions. Methane is the hydrocarbon most resistant to chemical change. It requires, therefore, higher temperatures (about 1000°C.) for thermal decomposition. Under such conditions, ethylene, acetylene, hydrogen, light oil, tar, and carbon are formed. It was generally believed that the pyrolysis of methane produced primarily carbon and hydrogen, and the formation of traces of aromatic hydrocarbons observed by Berthelot[1] was considered as a secondary reaction.

Fischer[2] was the first to show that by use of a proper temperature and contact time at atmospheric pressure, the formation of gaseous and liquid hydrocarbons having more than one carbon atom is the main reaction, and carbon formation is negligible. As far as ethane and methane are concerned, there is a difference of more than 200°C. between their respective thermal decomposition temperatures. The primary products of ethane at a temperature of about 600°C. are ethylene and hydrogen, this decomposition being straight dehydrogenation.

RAFAEL FUSSTEIG

has been affiliated with the petroleum industry since 1923, principally as chemist and engineer—At present he is professor of petroleum technology in the Ecole Superieure Technique et Commerciale de Paris, Paris, France, and maintains an office as consulting petroleum engineer at Jaroslaw, Poland, Kraszewskiego, 16.

If a mixture of methane and ethane is subjected to temperatures below 900°C., only a small amount of methane will undergo any change. Propane submitted to a temperature of 650°C. results in 51 percent dehydrogenation, 38 percent demethanization, and 11 percent are other reactions[3]. The demethanization is the severance of methane from the propane molecule according to the following reaction: $C_3H_8 \rightarrow CH_4 + C_2H_4$. Neuhaus and Mark[4] found that n-butane when submitted to a temperature of 600°C. resulted in 48.5 percent demethanization, 34.5 percent deethanization, and 16 percent dehydrogenation. From the above, it is apparent that each reaction, whether demethanization or dehydrogenation, leads to the formation of unsaturated gaseous hydrocarbons.

In the first case only half of the initial quantity of gas will be converted into unsaturates; in the second case the entire volume will be transformed into gaseous olefins. From the technical viewpoint, the purpose of adapting the decomposition process to natural gas is to attain a maximum yield of gaseous olefins. The greater this yield the higher the gasoline yield in the second step, that is, in the polymerization process.

The use of catalysts in this process plays a very important role. Zanetti and Lesslie[5] were the first to find that iron and nickel strongly catalyzed the decomposition of methane into carbon and hydrogen. In recent years, other experimenters have proved that these metals so contribute to decomposition and dehydrogenation of natural gas that different olefins are formed. Of course, the temperature and contact time used in the second case differ entirely from those of Zanetti and Lesslie, who used much higher temperature and contact time.

The decomposition of saturated gases requires two types of catalysts. The first must exhibit mild dehydrogenation reactions; the second showing demethanization reaction. In the first case only olefins will be produced, and in the second case the hydrocarbon will be split into paraffinic and olefinic fractions. Frolich and Boeckeler[6] propose reduced zinc oxide-chromium oxide catalyst for the production of olefins from paraffinic gaseous hydrocarbons higher than methane. A catalyst of 30.2 mol percent zinc and 69.8 percent chromium when employed in the decomposition of propane at 650°C.

[1]Compt. rend., 1862, 517.

[2]Brennstoffchemie, 1932, 406.

[3]Schneider and Frolish, *J. Ind. Eng. Chem.*, 1931, 1405.

[4]*Ind. Eng. Chem.*, 1932, 400.

[5]*Ibid.*, 1916, 777.

[6]U. S. P. 1, 944, 419.

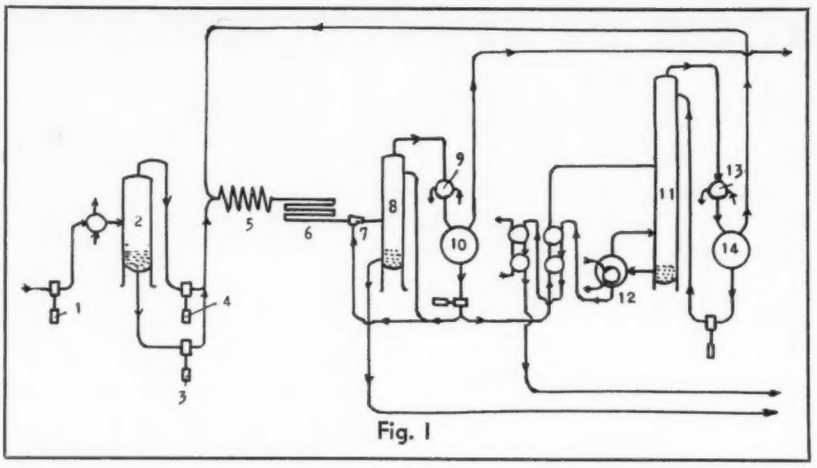


Fig. 1

produced a gas containing 14.3 percent propylene, 0.2 percent ethylene, 26.1 percent hydrogen, and 59.4 percent residual propane without appreciable formation of coke.

The I. G. Farbenidustrie has developed a process for the decomposition of gaseous paraffinic hydrocarbons in which a number of catalysts are proposed that are capable of causing a maximum separation into gaseous unsaturated raw material for the polymerization process. The most important of these are various oxides of magnesium, zinc, vanadium, copper, uranium, and silver; iron oxide, tin, molten metals or salts, salts of metaphosphoric acid, and various copper and nickel catalysts. There are many opinions concerning the action of catalysts in the cracking of gaseous saturated hydrocarbons.

According to one opinion, the catalyst guides the flow of reactions; other opinions are that none of the known catalysts shows marked activity and consequently does not influence the character of the reactions but merely lowers the temperature at which a given amount of reaction may be obtained. As mentioned in a previous article by the writer, the conversion to olefinic hydrocarbons may be executed by either of two methods: the "thermal" process, wherein heat and pressure are employed to effect the reactions, and the "catalytic" process in which some heat is used but in which polymerization is accelerated by proper catalysts.

The thermal process converts ethylene as well as propylene and butylene into polymers, whereas the catalytic methods do not polymerize ethylene to any great extent. It is very important, therefore, to provide a proper starting material for each of these methods. In the first case the natural gas may be cracked under normal conditions, but in the catalytic process the natural gas should be decomposed in a manner that prevents the formation of ethylene. Of course, in both cases, the concentration of olefins plays a very important part in the second polymerization process. The cracked gases, therefore, are processed to eliminate the lower-molecular saturated hydrocarbons such as methane and ethane so far as is practicable, and to concentrate the active olefins.

This concentration may be obtained either by absorbing the higher-molecular-weight hydrocarbons of the gas and recovering them from the absorbing medium as a liquid by using high pressure, or by separating and fractionating directly under pressure. In the event that these methods are used, the amount of ethylene in the initial gas is relatively small, as it would require very high pressure or low temperature to reduce it to the liquid state. Such concentration is important, therefore, in the catalytic polymerization of olefins because ethylene does not polymerize to a great extent in this process. Besides, when using the high-temperature-low-pressure polymerization, the gasoline yield is only slightly reduced, because ethylene polymerizes too far, forming tar if the operation is executed at the proper temperature for the propylene-butylene reaction.

From the above it is obvious that cracked gases having a high content of olefins require quite different conditions from those for a gas having concentrated propylene-butylene fractions and only a small amount of ethylene. In the first case low temperature and high pressure should be used; in the second case high temperature and low pressure is employed. Of course, the propylene-butylene fraction can also be submitted to low temperature and high pressure. The yield of distillate seems to be somewhat higher for the low-temperature-high-pressure operation than for the high-temperature-low-pressure process when operating on the same initial gas.

According to Cooke, Swanson, and Wagner, the character of the distillate produced under the conditions mentioned varies widely. The distillate obtained by the high-pressure-low-temperature method is comparatively volatile and would be suitable for blending only if the other component of the blend were completely non-volatile. On the other hand, the high-temperature-low-pressure operation produces polymerized liquids that are virtually aromatic, and the volatility is low. This indicates that the gasoline produced by the second method will probably have a higher octane number than that produced by the first.

The thermal process of Alco Products, Inc., may be used to polymerize two types of gases: (1) gases rich in olefinic hydrocarbons, and (2) gases poor in olefinic hydrocarbons. In the first case the cracked gas from the

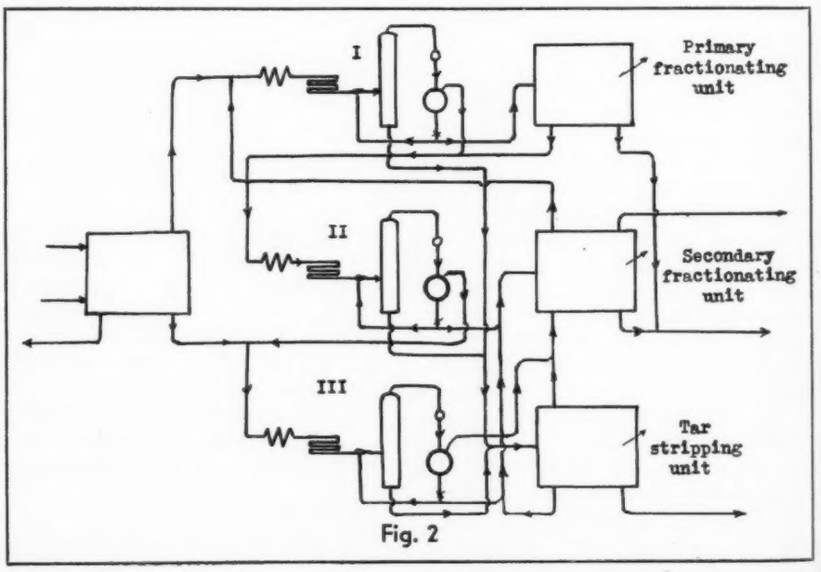


Fig. 2

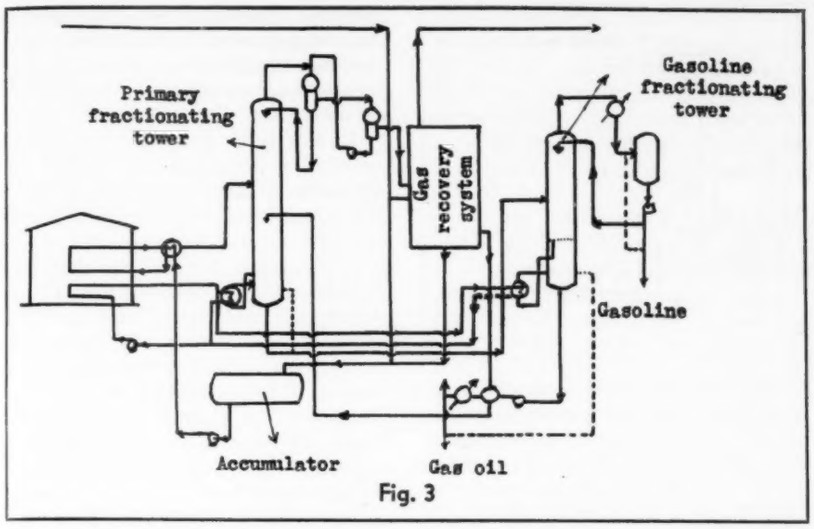


Fig. 3

gyro-cracking-system is submitted to a polymerization process under temperature of 480°-540° C. and pressure of 42-56 atmospheres. Fig. 1 is a flow chart of this process.

The cracked gas leaving the gyro-system is compressed at (1) and directed to the pressure vessel (2). The liquid hydrocarbons condensed under pressure are pumped by means of pump (3) to the pipe-still (5). The uncondensed gases can be compressed for return to the pipe-still by means of the compressor (4). The heated charging stock enters the reaction chamber (6), the so-called polymerization coil, in which the reaction takes place. The reaction products, immediately upon leaving the coil, are chilled in the arrester (7) to stop any further reaction. This step is necessary in order to absorb the exothermic heat of reaction. The cooling is accomplished by injection of either cold gas or oil. Simultaneously, the reaction mixture is cooled to a temperature low enough so that heavier products will be dropped-out in the separator (8). Gases, distillate vapors, and the chilling medium forming the overhead from this separator pass through the chiller (9) before entering vessel (10). The uncondensed gases and vapors from this vessel are passed directly to the pyrolysis unit. Part of the condensed hydrocarbons from vessel (10) is used as the chilling medium previously referred to, and the rest is pumped to the fractionation tower (11), where the polymer distillate is stabilized, that is, the lower-molecular hydrocarbons are removed by fractionation, aided by the heater (12). The overhead vapors from this fractionation tower are directed as a recycle gas to the pipe-still (5), whereas the polymer gasoline after passing through heat exchangers and chillers, flows to a gasoline tank.

According to Heinze[7], initial gas containing 15 to 35 percent propylene and butylene, under the above conditions produces 112 kg. gasoline per 100 cu. m. of gas. Only the cracked gas from the gyro-vapor-phase-system is rich in olefins, the gas from the liquid-phase-cracking being poor in olefins. Such gases, therefore, as well as natural gas must be first "olefinized," that is, dehydrogenated to increase the olefin content. Gases poor in or free of unsaturated hydrocarbons can be processed in a system developed by The Pure Oil Company, involving three-unit operation, which results in a maximum yield of a high-octane distillate. Fig. 2 shows the process.

In the first unit (I) a temperature of 480° to 540°C. and a pressure of 42 to 56 atmospheres is used. In this first step polymerization of propylene and butylene takes place. In the second step (II) the pyrolysis operation cracks paraffinic hydrocarbons at temperatures above 700°C. This step prepares the gases poor in or free of olefins for the polymerization reaction. In the third unit (III) the olefinic gas from the pyrolysis operation is treated under a temperature of 680°-700°C. and a pressure of 3 to 5 atmospheres. The process in the first step has already been described (Fig. 1), this apparatus being called "the primary poly unit." In the second unit, the so-called "gas pyrolysis unit," the reaction time must be as short as possible. This is necessary to prevent the unsaturated hydrocarbons entering into secondary reactions and forming tar. According to Cooke, Svanson, and Wagner[8], the products of reaction are chilled to a temperature low enough to liquefy compounds in the fuel oil and tar. Gases, distillate vapors, and vaporized chilling oils pass overhead from the tar separator to a condenser and accumulator, in which the chilling material is condensed. The gas remaining after compression and cooling is charged to the third unit, the so-called "secondary poly unit," for further polymerization at high temperature and low pressure.

The chilling of the conversion product, tar separation, and condensing of chilling medium, is analogous to the method used in the "primary poly unit." It must be noted, however, that inasmuch as the reaction products contain a high percentage of methane and hydrogen, recovery of polymer distillate cannot be executed by condensation under the low pressure. This can be effected only by compression and subsequent condensation.

This multi-coil system has an economic advantage, because it is capable of treating all types of gaseous hydrocarbons. It is evident that the "primary poly unit" yields gasoline of lower boiling range and that the gasoline produced by the second step has a higher boiling range. The polymer gasolines obtained in this process have an octane number of 100 to 105 and contain about 95 percent of aromatics.

The thermal process of the Phillips Petroleum Company consists of two principle parts: the polymerization unit, and the gas and cycle-recovery system. The polymerization schedule will usually vary with feedstock composition only to the extent of arrangement of reaction-coil surface. On the other hand, the precise type of gas and cycle-stock recovery system to operate at lowest overall cost is quite dependent on feed compositions, and, therefore, will vary with this factor. According to Keith and Ward[9] this system is available for the direct processing of both saturated and unsaturated hydrocarbons. It may be considered as a two-stage process in which the initial gas is first submitted to polymerization conditions, followed by separation of liquids; the second step consisting essentially of a unitary process for converting the residuum. By the proper choice of temperature and pressure, polymerization and cracking of gas components may be effected simultaneously, the control being such as to produce a liquid product.

When either refinery or natural gas is charged to this thermal polymerization system, the hydrogen, methane, and a portion of the ethane in the fresh-feed and polymerization-coil gas are separated from the higher-molecular-weight components and discharged as residue gas. Feed to the high-temperature polymerizer-coil may

[7]Chemische Fabrik, 1936, 109.
[8]Paper presented before A.P.I., November, 1935.
[9]*Ibid.*, November, 1935.

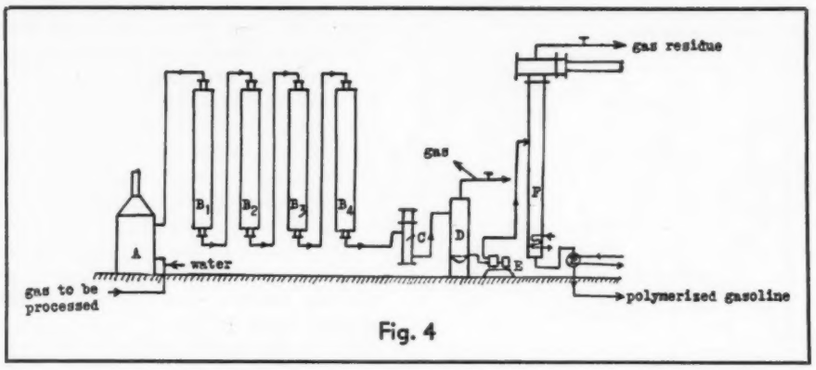


Fig. 4

have a composition varying from propane or butane alone or any combined proportions of these to a complex mixture of C_2—, C_3—, and C_4— compounds in which unsaturates vary from zero to 80 percent. Yields are obtained that approach the ultimate by recycling the C_2—, C_3—, and C_4— components leaving the polymerization coil. Temperature and pressure conditions in the polymerization zone range from 500° to 600°C. and 70 to 200 atmospheres, respectively, depending upon feed analysis. In this process polymerization and cracking are executed simultaneously by the proper choice of conditions. Fig. 3 is a flow sheet of this system.

The characteristics of the portion of the polymerization product that boils in the motor fuel range vary quite widely as functions of feedstock composition and operating conditions. The use of feedstock high in unsaturates at high conversions-to-liquid-per-pass appears to result in a product lower in gravity and paraffin content that when low-unsaturate stock is used. Aromatics and mono-olefins appear to predominate in the product from the high-unsaturate feed.

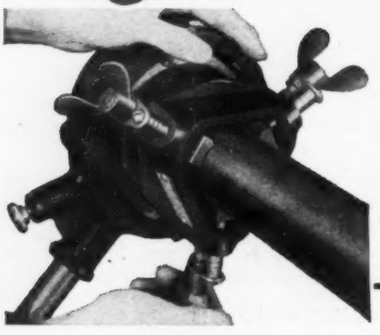
Turning to catalytic polymerization, the process of the Universal Oil Products Company operates on gases containing olefins. The source of these gases may be the cracking process or the catalytic dehydrogenation or cracking of propane-butane into olefinic hydrocarbons. This operation may be conducted as follows:

1. Catalytic dehydrogenation of gaseous paraffinic hydrocarbons such as propane and butane into propene and butene, followed by catalytic polymerization. This operation is conducted at atmospheric pressure and a temperature of about 500°C.

2. Catalytic polymerization of cracked gases containing olefinic hydrocarbons, using a pressure of about 15 atmospheres and a temperature of 230°C.

This process has been developed by Ipatieff, Egloff, and others of the Universal Oil Products Company. The flow diagram is shown in Fig. 4.

In the catalytic polymerization process the olefin-containing gas is heated to about 230°C. under a pressure of about 15 atmospheres in heater (A), from which it flows into the top of a solid-phosphoric-acid catalyst chamber (B_1), and thence to the catalyst towers (B_2), (B_3), and (B_4), in series. In these reaction towers the required reactions take place, these reactions being mildly exothermic. The polymer-gasoline vapors thus formed pass through a cooling coil (C) to a receiver (D). In this receiver the polymer gasoline is separated from the uncondensed gases and pumped by means of the pump (E) to the stabilizer (F), to obtain a product of the desired vapor pressure. The residue gases from the stabilizer and from the receiver containing amounts of propane and butane principally, must be



YOU CAN'T BUY A BETTER TOOL

...for 1- to 2-inch pipe than a "TOLEDO" No. 1-BR Ratchet Threader.

Finest of materials and workmanship. Four sets of dies—a separate set for each size pipe—assuring precision threads on all sizes and easier cutting. Two-inch dies are made from high-speed steel.

Long-life pipe holder—easy, quick, accurate centering. Three broad-faced jaws hold tool firmly to pipe—tool cannot wobble or cock on pipe—assuring good threads straight on the pipe for straight line piping.

For good threads, easy cutting and long life specify a "TOLEDO" No. 1-BR at your local dealer.

THE TOLEDO PIPE THREADING MACHINE COMPANY
TOLEDO, OHIO NEW YORK OFFICE, 72 LAFAYETTE STREET

"TOLEDO"
TRADE-MARK REGISTERED

YOU'LL DO BETTER WITH A "TOLEDO"

dehydrogenated catalytically into propene and butene. This occurs at atmospheric pressure and 500°C. temperature in three recycles, and the gas is then pumped into the polymerization unit. In this method about 75 percent by weight of the original gaseous hydrocarbons can be converted into gasoline of 81-83 octane number.

Another type of operation of this system is to "debutenize" completely a gas, that is, to remove all the butane and butene from the cracked gasoline by deep stabilization. By this operation the butene normally present in the cracked gasoline as well as in the stabilizer gas is converted into a polymer of low vapor pressure. The butane and butene present in a normally-stabilized gasoline are replaced by the butane that passes through the polymerization apparatus unchanged and are recovered. When subjecting this type of stabilizer gas to catalytic polymerization, the yield of gasoline will be 8.3 gal. per M. cu. ft. According to Egloff, a yield of 14.2 gal. of polymer gasoline per M. cu. ft. is obtained when calculated on the basis of C_3-C_4 fractions of gas including the butane added to the deeply-stabilized cracked gasoline.

The above-mentioned catalytic polymerization process is capable of converting the isobutene into isoöctane-gasoline. The isobutane present in refinery gas, cracked gas, and natural gas can be catalytically dehydrogenated into the correponding olefin, then polymerized catalytically into isoöctene, and finally hydrogenated into isooctane-gasoline of 95-100 octane number.

A very interesting method of catalytic polymerization of butylenes is the operation employing sulphuric acid. Shell Development Company[10] proposes the production of isoöctane by means of sulphuric acid. This process can be carried out (1) by the cold sulphuric-acid process, or (2) by the hot-acid process. In the first case the liquid hydrocarbon is contacted by 60 to 70 percent sulphuric acid at 20°-35°C. countercurrently in two stages. In the second case, polymerization is executed at a temperature above 60°C.

When using the cold process, isobutylene, the more reactive of the olefins, is selectively absorbed into the acid phase. This absorption is dependent upon the strength of the acid and the temperature. In other words, the stronger the acid and the lower the temperature the more complete is the absorption of isobutylene. When the acid phase becomes saturated by the desired amount of isobutylene, it is separated from the hydrocarbon phase and passed through a separate polymerization unit consisting of coils heated to a temperature of 100°C. After one minute the butylene is polymerized to isoöctene, which, after a mild hydrogenation, is converted into the valuable isoöctane.

As far as the hot system is concerned, McAllister has stated that when the temperature of the acid-absorption reaction is increased, the absorbed isobutylene present in the acid phase condenses to polymer, and this is reabsorbed into the hydrocarbon phase. At temperatures above 60°C. this polymerization is sufficiently rapid so that the absorbed isobutylene has only a transitory life in the acid phase, and the process becomes truly catalytic. This hot-acid process shows a more economic advantage than the former because the cold-acid process yields 75-80 percent of octenes, but the hot-acid polymerization yields 85-90 percent of octenes.

From the above it may be concluded that there are many procedures available for the polymerization of gases into gasoline of high-octane number, the choice of which depends upon the type of gas, upon the cost of the equipment, and upon the production cost.

[10] *Ibid.*, November, 1937.

Let "CLEVELANDS" STREAMLINE YOUR DITCHING and BACKFILLING COSTS

MODEL 140

Cleveland presents the Model 140, toughest, fastest, most dependable Cleveland ever built. Has new, wide tread; longer, wider crawlers; increased ground clearance and wider digging widths (ranging from 18" to 30"). New "Multi-Speed" crawler transmission, X-braced frame, box-member boom, 100% fabrication from hi-strength steel.

Cleveland has successfully eliminated wasteful dead weight with its attendant clumsiness—and *simultaneously*, increased performance, in these two recent additions to its line, here illustrated.

Leading pipeline companies and contractors recognize this achievement by purchasing Clevelands for use on current projects in the U. S. and foreign countries.

Only Clevelands give you that well-balanced combination of dependability, speed and maneuverability which streamlines your ditching and backfilling operations, resulting inevitably in lower job costs.

MODEL 90

Revolutionizes backfilling methods. A universal machine, handles backfilling on small or large diameter lines. No dirt too heavy. No crop-damage. Fills 2 to 3 miles per day, even in rough country. Lowers in slack-loops, eliminating need for separate piece of equipment. Diesel or gasoline-powered. The only One Man Operated, Continuous-Travel Backfiller on the market.

THE CLEVELAND TRENCHER COMPANY
20100 ST. CLAIR AVENUE CLEVELAND, OHIO

CLEVELANDS

LAUGH WITH BARNEY

Did you hear about the Southern Illinois producer getting lost in St. Louis? He thought he was on Olive and it was Grand.

"Isn't this antique furniture gorgeous? I wonder where Mrs. Batts got that huge old chest."

"Well . . . they tell me her old lady was the same way."—*The Core Driller.*

The reason the Indians won't support the Townsend Plan is they don't want their squaws making two-hundred bucks a month.

Youth (at stage door): Is the Hula dancer in the room?

Watchman: Son, she's 'round at the rear.

Youth: I know that, but answer my question.

Nights are six months long for old maids and Eskimos.

There was an old lady
Who lived in a shoe,
She had so many children
She didn't know what to do
Evidently.

Hal: What do three balls in front of a pawn shop mean?

Jim: Two to one you don't get it back.

A well known official of a telephone company was rudely aroused from his slumbers on a cold night by the ringing of the telephone. Bruising his knee on a chair, he reached his phone.

"Hello," he growled.

"Are you an official of the telephone company?" asked the voice.

"Yes, what can I do for you?"

"Tell me," said the voice, "how it feels to get out of bed at 2 o'clock to answer a wrong number."

Hoozat!

I crept up stairs, my shoes in hand,
Just as the night took wing,
And I saw my wife, four steps above,
Doing the same darned thing.
—*Dirge.*

It's all right for a woman to hold on to her youth, but not while he is at the wheel.

Not That Bold

Ma: That new couple next door seem to be very devoted. He kisses her every time they meet. Why don't you do that?

Pa: I don't know her well enough yet.

Sheriff: Say, young lady, there's no swimming here in this lake.

Beautiful: Well, why didn't you tell me that before I got undressed?

Sheriff: Wal, there ain't no law agin' that.

Expert Lingo

Waitress: Hawaii, gentlemen. Yuse must be Hungary to eat in a dump like this.

First Man: Yes, Siam. And we can't Rumania long, either. Venice lunch ready?

Waitress: I'll Russia to a table. Will you Havana?

F. M.: Nome. You can wait on us.

Waitress: Good. Japan the menu yet? The Turkey is Nice.

F. M.: Anything at all. But can't Jamaica little speed?

Waitress: I don't think we can Fiji that fast, but Alaska.

F. M.: Never mind asking anyone. Just put a Cuba sugar in our Java.

Waitress: Sweden it yourself. I'm only here to Servia.

F. M.: Denmark our bill and call the Bosphorus. He'll probably Kenya. I don't Bolivia know who I am.

Waitress: No, and I don't Caribbean. Youse guys sure Armenia.

Boss: Samoa your wisecracks, is it? Don't Genoa customer is always right? What's got India? You think maybe this arguing Alps business?

Customer: Canada racket. 'Spain in the neck.

Two old Scotsmen sat by the roadside puffing solemly at their pipes.

"There's no' much pleasure in smoking, Donald," said Sandy.

"Hoo dae ye mak' that oot?" questioned Donald.

"Weel, if ye're smoking yer ain bacca, ye're thinkin' o' the awful expense, and if ye're smoking some ither body's y'r pipe's rammed saw tight it winna draw."

Conductor: Madam, you'll have to pay full fare for that child. He is over six years of age.

Madam: But I've only been married five years.

Conductor: Never mind the true confessions—gimme the money.

Two salesmen introduced themselves to two attractive young girls in a hotel lobby:

"We're the Chesterfield boys. We're mild, but we satisfy."

Attractive young girls: We're the Piggly Wiggly girls. We have everything, but we don't deliver.

"You say that I am the first model you ever kissed?"

"Yes."

"And how many models have you had before me?"

"Four. An apple, two oranges and a vase of flowers."

Unexpurgated

A colored preacher was hearing the rather lengthy confession of a young fellow in his congregation. Stopping him at last he said, "Young man, you ain't confessin'; you'se braggin'."

Game Dame

A handsome midshipman wandered into a tennis tourney late one afternoon. He sat down beside a demure young lady and asked, "Who's game?"

"I am," said the bashful one.

New Worlds to Conquer

"Does your wife ever pay you any compliments?"

"Only in the winter."

"In the winter? How do you mean?"

"When the fire gets low, she says, 'Alexander, the grate!' "

"I see the jury acquitted the girl who killed her employer, on the ground of insanity."

"Yes, and quite right, too. Anybody who kills an employer these days is certainly crazy."

The rumor is going around that the snake in the Garden of Eden may have been the original traveling salesman.

GOOD NEWS

FOR WELL OPERATORS

New Designs of Bethlehem-International Pumping Units offer 4-WAY Savings

Want to increase your profits? Want to cut the cost-per-barrel of bringing your oil above ground?

Here's good news for economy-minded operators. A new series of Bethlehem-International Pumping Units has been designed to meet modern requirements in pumping efficiency. These new designs are the result of over thirty years of experience in supplying equipment to pump oil economically.

Available in a wide range of sizes and strokes, these Bethlehem-International Pumping Units offer you four-way savings.

LOW UNIT COST—Call at the Bethlehem-International Store nearest you and find out how little it costs to buy one of these new streamlined pumping units.

LOW INSTALLATION COST—The foundation requirements are economical. Frames are designed simply, requiring minimum forming for permanent installation on concrete and little cribbing on temporary settings. High sampson posts enable horseheads to clear well connections with no need for elevating the entire unit on expensive foundations.

LOW MAINTENANCE—Every feature of these new units is designed to give you long, trouble-free, inexpensive service. Throughout the reduction units, for example, drop forged steel gears are provided—an assurance of long life.

LOW OPERATING COST—Each size of pumping unit is adapted to the most economical type and size of prime mover. Gear ratios and belt ratios are provided so that maximum prime mover torque can be most efficiently applied. Large, well lubricated anti-friction and sleeve bearings carry this torque to the well loads with minimum power loss.

Let a Bethlehem-International representative help you to select the pumping unit best adapted to your well operating conditions. You may be agreeably surprised at how much you can save by installing one or more of these new B-I Pumping Units—designed for economy.

Call **BETHLEHEM-INTERNATIONAL** *for Service*

BETHLEHEM-INTERNATIONAL SUPPLY COMPANY

Subsidiary of Bethlehem Steel Company

General Offices: Tulsa, Oklahoma

Running Tour
WITH MEN IN THE INDUSTRY

R. C. FARLEY, engineer, who has been at Jefferson, Texas, for the Ohio Oil Company, is now at Henderson, Texas.

W. G. SELBY, vice-president of the Selby Oil and Gas Company, is now making his home at Sarasota, Florida, having moved there from Ennis, Montana.

LARRY E. SIMON

LARRY E. SIMON, formerly of the National Refining Company's engineering department, has been appointed a district representative of the Jensen Brothers Manufacturing Company, Coffeyville, Kansas. He will have charge of Jensen Jack sales in New York, Pennsylvania, Ohio, West Virginia, and eastern Kentucky and will make his headquarters in Bradford, Pennsylvania.

R. W. COLLINS, engineer for the Stanolind Oil and Gas Company, has been transferred from Elk Basin, Wyoming, to Loyd, Colorado.

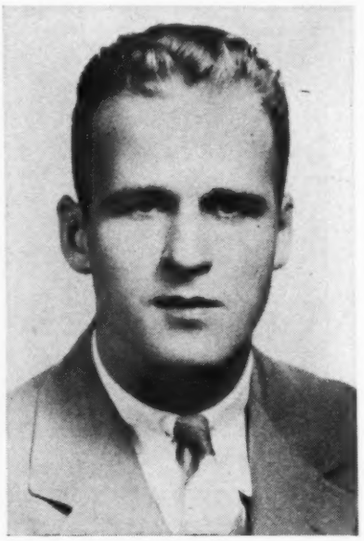
FINLEY DOYLE, geologist, Sun Oil Company, is now stationed at Evansville, Indiana, formerly having been at Morganfield, Kentucky.

R. E. WISE, an engineer for the Continental Oil Company, recently was moved from Ville Platte, Louisiana, to East St. Louis, Illinois.

NORVAL NICHOLS, a geologist with the Superior Oil Company at Midland, Texas, has been transferred to an affiliated company, Superior Oil Company of New Zealand, Ltd., and sent to Chalmers, Palmerston, North New Zealand.

THEODORE CHAPIN, geologist for the Cities Service Oil Company, has been transferred from Houston, Texas, to New Orleans, Louisiana.

EVANS POWELL has been appointed district manager in the Rocky Mountain territory for the Union Wire



EVANS POWELL

Rope Corporation, having his headquarters at 26th and Walnut streets, Denver, Colorado. Powell has been at the company's main office in Kansas City, Missouri.

HARRY BRETT, superintendent of production, Southern Division, Union Oil Company of California, has been moved to the Coast Division to take charge in the absence of **W. H. WATKINS,** who is on sick leave.

MAURIE WALTERS, who has been manager of the Grand Rapids, Michigan, district of the Imperial Refining Company, Pipe Line Division, has been made manager of the southwestern Michigan district of the Tri-Lake Corporation, Pipe Line Division, a subsidiary of the Standard Oil Company of Ohio. **G. H. HADLEY** has taken Walter's former post with Imperial.

ROBERT WELLS, of the public relations department of the Standard Oil Company of Venezuela at Caracas, has been transferred to Buenos Aires where he will be engaged in similar work for the company.

W. C. ADAMS, drilling contractor, has moved his headquarters from St. Elmo, Illinois, to Paw Paw, Michigan.

PAUL HESSE, warehouseman for the Lago Petroleum Company, La Salina, Venezuela, was a recent visitor in Houston, Texas.

CHASE SUTTON, manager, Gulf Coast Division, Pure Oil Company, Houston, Texas, made an airplane trip to South America recently.

JOHN ROBERTS, Maracaibo, Venezuela, drilling superintendent for the Caribbean Petroleum Company, has been visiting in Houston, Texas. Upon his return he will be stationed at San Cristobal, near the Colombian border.

R. C. WARD, geologist for the Superior Oil Company, has returned to Houston, Texas. He has been stationed at Evansville, Indiana.

L. J. PALMER, drilling contractor, has transferred his activities from Owensboro, Kentucky, to Percilla, Texas.

L. D. MURRAY

L. D. (JIGGS) MURRAY, American Iron and Machine Works Company, Oklahoma City, Oklahoma, and Houston, Texas, has been made sales manager for the states of Louisiana and Arkansas, having headquarters in Houston, Texas. Murray, before going with the American Iron and Machine Works Company two years ago, was in the sales department of the Bovaird Supply Company.

E. B. ECKEL, associate geologist on the staff of the U. S. Geological Survey, has been made a member of the teaching staff of Purdue University. He will be under **DR. J. L. BRAY,** professor of metallurgy.

"Beauty"

—That's More Than Paint Deep!

Sure, it's a pretty job. But it wasn't bought for its beauty. Most any pumping unit will make an attractive picture, given the right background . . . and a new paint job. The "beauty" about this unit is that it has been running a long time . . . has produced a lot of oil . . . and has never cost its owner a cent for repairs or lost time. And the dependable, trouble-free performance of this unit didn't just happen. There are Parkersburg pumpers, of this and other types, making equally good records throughout the oil fields of the world. Check, with any user, the fine features of Parkersburg pumping unit design and construction; then ask yourself this question: "Can I afford NOT to buy this pumping unit quality?"

THE PARKERSBURG RIG & REEL COMPANY

PARKERSBURG, W. VA.

DALLAS HOUSTON TULSA ST. LOUIS LOS ANGELES NEW YORK

D-10-39

THE PARKERSBURG RIG AND REEL CO.

PARKE A. DICKEY, geologist, who has been at Titusville, Pennsylvania, for the Penn State Geological Survey, is now at Pleasantville, Pennsylvania.

PIET SCHOUTE, exploration engineer for Bataafsche Petroleum Mij., left Los Angeles, California, recently to return to the Dutch East Indies.

H. E. FRYE has been appointed district manager for the Union Wire Rope Corporation, Kansas City, Missouri, in its Gulf Coast sales territory. He will make his headquarters in Houston, Texas. Frye has been with the company as a salesman since its organization in 1926, serving first in the Kansas oil fields and later in the Portland, Oregon, district.

H. E. FRYE

C. H. LANG, manager, has announced the appointment of three assistants of the General Electric Company publicity department. **W. V. MERRIHUE** was named in charge of the apparatus division, **R. L. GIBSON** in charge of the general publicity division, and **B. J. ROWAN** in charge of the administrative and production division. The appointments were effective immediately.

W. E. WILLIAMSON, chemist for the O. C. Field Gasoline Company, is now stationed at Montebello, California, formerly having been at Huntington Beach, California.

M. G. EDWARDS, superintendent of the Long Beach, California, district for the Shell Oil Company, Inc., has been promoted to manager of operations of the same district.

L. C. ROBERTS, JR., geologist for the Stanolind Oil and Gas Company, who resigned recently to operate as a consultant, has opened offices at 2527 Gulf Building, Houston, Texas.

C. R. SPENCER, who has been doing geophysical work in Arabia with the California Arabian Standard Oil Company, is now back in Houston, Texas.

T. E. MOBLEY, vice-president of the Standard-Vacuum Oil Company, New York, New York, was a recent visitor on the Pacific Coast. He has returned to the East.

H. F. GIBSON of Gibson and Jennings, Inc., drilling contractors, is now making his headquarters at Sandoval, Illinois, having moved from Mount Vernon.

L. H. CRON and **E. J. GRACEY,** well-known drilling contractors of Houston, Texas, together with **W. H. MARTIN,** have formed the Cron and Gracey Drilling Corporation.

HENRY KIMBLE, geologist for the Magnolia Petroleum Company, has been transferred from Watonga, Oklahoma, to the company's headquarters in Dallas, Texas.

J. O. GARRETT, engineer for the Big Lake Oil Company, is now making his headquarters at Corpus Christi, Texas. He has been at Texon, Texas.

J. S. WALTON, engineer, Standard Oil Development Company, has been transferred from Westfield, New Jersey, to Iowa City, Iowa.

ART L. WALKER, due to ill health, has resigned as secretary of the Interstate Oil Compact Commission. He originally submitted his resignation in June but was prevailed upon to take a vacation with the hope that the rest would enable him to continue in the office. His physicians now advise him, however, that because of an enlarged heart he should give up all strenuous activity. **CHARLES L. ORR,** Holdenville, Oklahoma, who has been attorney for the compact commission, has been appointed secretary to succeed Walker.

D. T. McIVER recently was appointed assistant to the president of the Freeport Sulphur Company. He has been assistant general manager of the company since 1933, and will continue in the performance of those duties in addition to his new ones. He has been stationed at New Orleans.

F. A. FARON, manager of the New Haven office, and **E. G. DUDLEY** of the industrial department, New York district, of the General Electric Company, have been named assistant managers of the industrial department of the New York district of the company, it was announced by **H. H. BARNES, JR.,** commercial vice-president. The appointments became effective October 1.

B. C. SIMPSON has been appointed to the Gulf Coast sales force of Western Sand-Banum Company, 703 M. and M. Building, Houston, Texas, distributors for Sand-Banum products. Simpson, who was formerly associated with the Control Equipment Company, is well known among those connected with the oil industry. He will sell the complete "Sand-Banum" line, which are pure colloidal concentrates developed for the control of scale and corrosion in boilers and engines.

J. E. BACKMAN, geologist, Gulf Research and Development Company, has been transferred from Ardmore, Oklahoma, to Weatherford, Oklahoma.

WILLIAM PARKER, Bartlesville, Oklahoma, vice-president of the Phillips Petroleum Company, recently made a trip to Los Angeles, California.

C. E. KLITGAARD recently was made assistant manager of the marine department of the Standard Oil Company of New Jersey. His headquarters will be in New York City.

H. R. CULLEN, president of the Quintana Petroleum Corporation, Houston, Texas, recently made a trip to New York City and other points in the East.

MALCOLM MITCHELL, engineer, has been transferred from El Dorado, Arkansas, to New York City by the Lion Oil Refining Company.

W. C. RODGERS, engineer for the Phillips Petroleum Company, has been moved from the company's main offices at Bartlesville, Oklahoma, to Oklahoma City, Oklahoma.

W. W. CLINE, vice-president of the Rocky Mountain Drilling Company, has moved his headquarters from Wyoming to Bakersfield, California.

PATRICK CLANCY has been given a three-year contract as a driller by the Trinidad Petroleum Company and left Black Diamond, Altamont, Canada, recently for Trinidad to assume his new duties.

ELMER CAMERON, Black Diamond, Altamont, Canada, left recently for Trinidad where he will be a driller for the Trinidad Petroleum Company.

JOHN P. HOELZEL, vice-president and general sales manager of the Pittsburgh Screw and Bolt Manufacturing Company, has been elected president of the company. Hoelzel is widely known throughout both the steel and petroleum industries, having spent considerable time in the oil areas, prior to his election as head of the company.

DANA J. FOX, for four years vice-president, treasurer, and a director of Fretz-Moon Tube Company, Butler, Pennsylvania, has been appointed assistant treasurer of The National Supply Company and will have his headquarters in the general offices of the company, Grant Building, Pittsburgh, Pennsylvania.

A native of Pittsburgh, Fox was for six years in the treasury department of the American Sheet and Tin Plate Company, then from 1919 to 1931 in the credit department of Republic Steel Corporation, and for the last eight years has been associated with the Fretz-Moon organiaztion.

DR. RUDOLPH SCHIDER, chief geologist of the Asiatic Petroleum Company, New York City, is now in Venezuela.

W. S. REID, manager of the International Petroleum Company at Lima, Peru, has returned to South America after making a visit to the United States and Canada.

NATHAN LYNCH, independent operator of Gladewater, Texas, has purchased the refinery of the Lacy Refining Company at Kilgore, Texas, and has changed the name to the Lynch Refining Company.

W. M. ANDERSON, vice-president of the Standard Oil Company of Brazil, was recently elected president of the company.

JOHN W. BRICE, of the Standard Oil Company of New Jersey, has been made executive assistant to H. E. Linam, president of the Standard Oil Company of Venezuela. He will make his headquarters at Caracas, Venezuela.

EDWARD C. BORREGO sailed from New York recently for Venezuela to become superintendent of Pedernales operations in eastern Venezuela for the Standard Oil Company of Venezuela. The last year he has been in Illinois and the Mid-Continent for the Carter Oil Company.

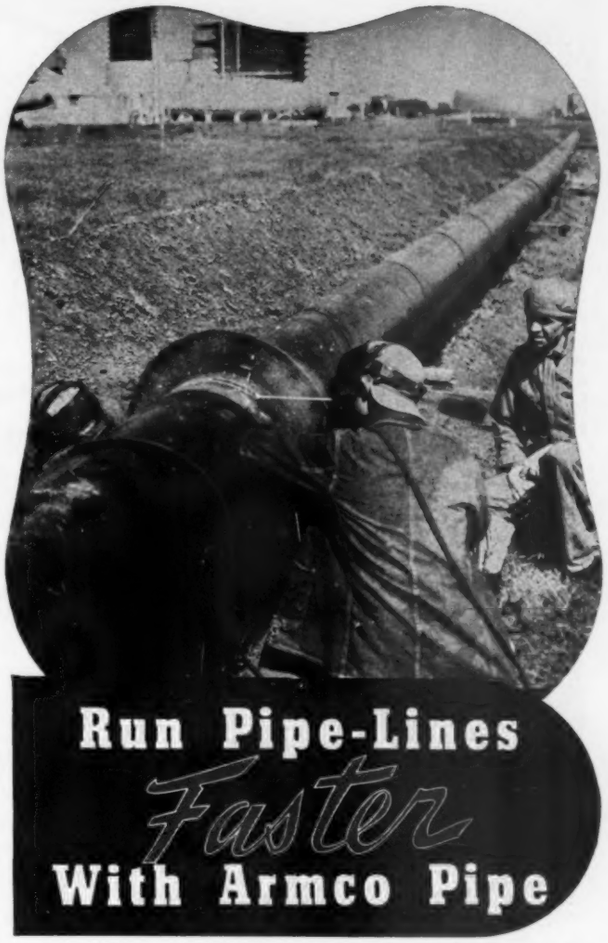
B. O. BIRD, production superintendent for the Phillips Petroleum Company, has been transferred from Marlow, Oklahoma, to Perry, Oklahoma.

H. G. SHOOK, who has been superintendent at West Columbia, Texas, for The Texas Company, is now at Conroe, Texas.

STANLEY S. SIEGFUS, geologist for the Socony-Vacuum Oil Company, has been transferred from Caracas, Venezuela, to Ciudad Bolivar, Venezuela.

E. L. LANDRETH, superintendent of the Landreth Production Corporation, has moved his headquarters from Corpus Christi, Texas, to San Antonio, Texas.

HARVEY WHITAKER, manager Bridwell Oil Company, Wichita Falls, Texas, has transferred his headquarters to San Antonio, Texas.



Run Pipe-Lines *Faster* With Armco Pipe

Saving time and money are good reasons for running gas gathering lines with Armco Spiral Welded Pipe. It goes in fast, cuts work, and saves you money in other ways.

Transportation and handling costs are less with Armco Pipe because it is free of excess weight. Uniform lengths eliminate guesswork and make for accurate cost estimates and lower bids. Ordered in fifty-foot lengths, there are fewer sections to unload, haul and string; fewer joints to field-weld. What's more, contractors like to work with Armco Pipe because they say it welds faster and more economically.

Order Armco Spiral Welded Pipe to exactly meet your needs. Diameters range from 6 to 36 inches; wall thicknesses from 7/64 to 1/2-inch. You have a choice of standard and special fittings and optional coatings. For prices and dependable delivery promises get in touch with our nearest office. The American Rolling Mill Company, Pipe Sales Division, Middletown, Ohio; 538 Mayo Bldg., Tulsa, Okla.; 3500 Maury Street, Houston, Texas.

ARMCO

ARMCO

SPIRAL WELDED PIPE

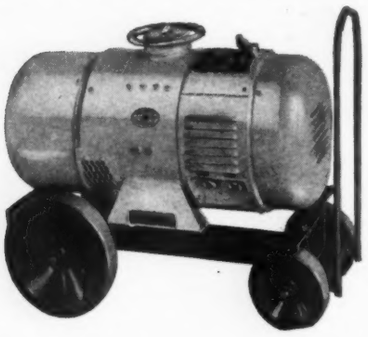
LINE PIPE AND SURFACE CASING

MACHINERY and EQUIPMENT

Wilson Electric Arc-Welder

A NEW single-operator, motor-generator, arc-welder, requiring only one control device for operation, has been announced by Wilson Welder and Metals Company, Inc., 60 East 42nd Street, New York, New York.

Known as the Wilson "Hornet", this welding machine employs for its control a single, simple handwheel situated on top of the unit. Adjustment of



this handwheel permits the operator to obtain an infinite number of current settings. Dial markings are so accurately calibrated that meters are not required, the manufacturers state.

Single-pole control design assures a current output that will not vary, resulting in a constant, uniform arc at all times, it is said. Accidental reversal of polarity is impossible because the electric current is so regulated that a small snap switch must be flicked by the operator to change the polarity.

The "Hornet" is a two-bearing unit, having motor rotor and generator armature mounted on a common shaft. Adequate ventilation is provided by propeller blades attached to the revolving shaft. Although shielded-arc electrodes are recommended, the "Hornet" will operate with equal efficiency when bare electrodes are used, the makers assert.

The Wilson "Hornet" is supplied in three sizes—Frame BA 200, rated 200 amp.; Frame BA 300, rated 300 amp.; and Frame BA 400, rated 400 amp. Further information and descriptive literature may be obtained by writing to the Wilson Welder and Metals Company, Inc., New York, New York.

"Sealtite" Weight Indicators By Martin-Decker

MARTIN-DECKER Corporation, Long Beach, California, has announced the development of "Sealtite" weight indicators said to eliminate the problem of fluid leaks even under the roughest drilling conditions. "Sealtite" indicators are permanently sealed at the factory and no further pumping or adjusting is necessary.

The "Sealtite" assembly consists essentially of two parts: the instrument itself and the diaphragm unit, both contained in a special steel box and permanently connected by special reinforced high-pressure hose and steel fittings. All copper tubing and copper fittings have been completely elimi-

nated in this new hookup. Installation procedure consists of clamping the steel case to a post in the usual manner, removing the diaphragm unit from the case and attaching to the dead line.

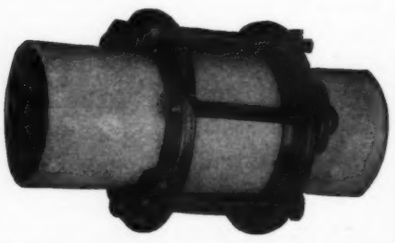
The "Sealtite" weight indicator gives direct readings in thousands of pounds as well as in points. It is indirectly illuminated for night work, and has an extra-large dial that can be easily read from a distance of 40 ft. The entire unit fits into a compact steel box, and can be readily moved from rig to rig whenever desired. It is instantly ready for use at all times without refilling or adjusting.

All Martin-Decker weight indicators, including the Quintuplex Drilling Control, are available in the "Sealtite" hookup for positive elimination of fluid leakage under all drilling conditions. For further information write to Martin-Decker Corporation, Long Beach, California.

Clamp Repairs Collar Leaks

FOR quickly stopping leaks through the threads of screw collars (screw couplings), Dresser Manufacturing Company, Bradford, Pennsylvania, is offering its style 41 repair clamp in sizes from 4½ in. to 12 in. I.D., inclusive. A smaller clamp of the same design, but having malleable followers instead of steel, is known as style 4, and comes in sizes ¾ in. to 4 in. I.D., inclusive.

According to the makers, the collar clamp consists of a few simple factory-made parts (followers, gaskets,



bolts), which are quickly assembled with only one tool—a wrench.

Advantages asserted for the Dresser collar clamp are simplicity, speed, efficiency, and permanent tightness.

The makers state that unskilled labor can easily apply the clamp without interruption of the service, under all normal pressures, and that the clamp can be supplied for any collar, old or new. Literature descriptive of the Dresser collar clamp is available from the Dresser home office at Bradford.

LUNKENHEIMER SERVES THE OIL INDUSTRY

with a Complete Line for Steam, Water, Air, Gasoline and Oil Service

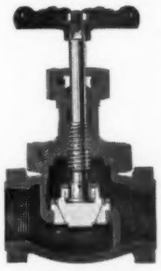


Fig. 1857-P
150 lb. S.P. Plug Type
All-Iron "Ferrenewo"

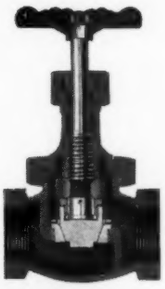


Fig. 16-P
300 lb. S.P. Plug Type
Bronze "Renewo"

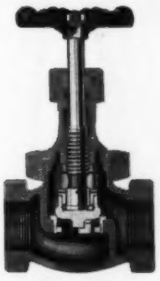


Fig. 1878
350 lb. S.P.
Bronze Globe

Fig. 1720
600 lb. S.P.
Steel Globe

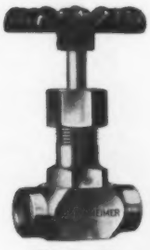


Fig. 1730
3000 lb. W.O.G.
Steel Needle Valve

Fig. 2125
125 lb. S.P.
Double Wedge Disc
Bronze Gate

Fig. 2129
125 lb. S.P.
Single Wedge Disc
Bronze Gate

Fig. 1640
150 lb. S.P.
Iron Body
"King-clip" Gate

Fig. 768
200 lb. S.P.
Single Wedge Disc
Bronze Gate

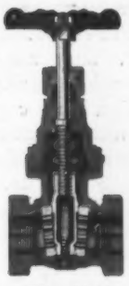


Fig. 1881
350 lb. S.P.
Single Wedge Disc
Bronze Gate

Fig. 1938-D2
300 lb. S.P.
Steel Gate

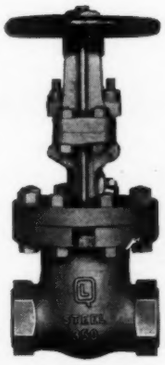


Fig. 1869-B6
350 lb. S.P.
Steel Gate

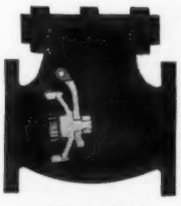


Fig. 1790
125 lb. S.P.
Iron Body Swing Check

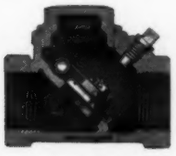


Fig. 1880
350 lb. S.P.
Bronze Regrinding
Swing Check

Fig. 1123
125 lb. S.P.
Iron Body Globe

Fig. 1430
125 lb. S.P.
Iron Body Gate

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI, OHIO, U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT 318-322 HUDSON ST., NEW YORK

CARRIED IN STOCK BY LUNKENHEIMER DISTRIBUTORS

National Unit Pumpers

THE NATIONAL SUPPLY COMPANY, Toledo, Ohio, has added two new unit pumpers to its line. These two pumpers are known as the Types TU234-JD23TB and TU234G-JD23 TP. They are designed for medium pumping service and are identical in design and capacity except for the cranks, counterweights, and pitman assembly. Maximum polished-rod stroke is 42 in. in each case and safe load of walking beam is 9125 lb. (A. P. I.). The A. P. I. peak torque rating is 57,200 lb. at 20 s. p. m. and overall gear ratio is 29.8.

The Type TU234-JD23TB Pumper has a fully equalized pitman assembly and is equipped with S. K. F. spherical roller bearing wristpin housings. National eccentric disk cranks and counterweights give infinitely and continuously variable adjustability both in counterweight effect and degree of lag and lead, the manufacturer states.

The Type TU234G-JD23TP Pumper is especially designed for installations where economy in first cost is of foremost consideration, the makers point out. Plain cranks having bronze bushed wristpin housings are used and the pitman assembly is of the unitary instead of the equalized type. Beam counterweights installed in any increments from one to eight allow a wide range of counterweighting.

Aside from the individual features described, the design of the two units is the same. Unusual resistance to vibration is provided by a strongly braced samson post of the four-legged type welded integrally with the frame. A steel ladder having a ring-type back rest allows safety and convenience for work at the beam level. The walking beam saddle and the beam pitman operate on roller bearings. Wide faced single helical gears, favorably proportioned and heat-treated for long wear, are carried on well-supported, heat-treated steel shafts of ample size equipped with Timken roller bearings. A complete description of these two units may be found in National's Bulletin No. 251.

Patterson-Ballagh Pipe Wiper

PATTERSON-BALLAGH Corporation, Los Angeles, California, offers the Patterson-Ballagh Pipe Wiper, which the manufacturers assert effects a great saving in mud, weight material, and water. Safety on the floor and in operations is also a feature.

The mud wiper is a flat reinforced disk of seamless rubber having a hole in the center of a flexible web, through which the drill pipe or tubing is pulled. The rubber is of the same quality as is used in the manufacture of Patterson-Ballagh casing protectors, open-hole stabilizers, wire-line guides, swivel bumpers, and rubber-lined nozzles.

The hole in the center of the pipe wiper is slightly smaller than the diameter of the pipe, and, as there is no break in the web, the mud or oil is "squeegeed" from the surface very completely.

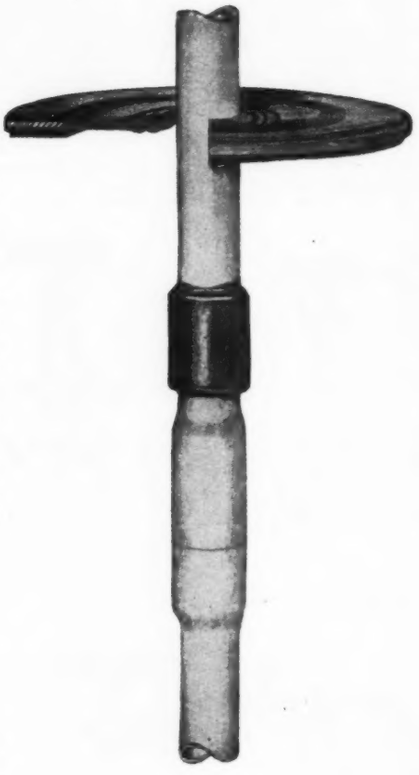
The web is so flexible that tool joints and protectors pass through without difficulty.

As no water is needed, there is no dilution and therefore no mud or weight material is added to compensate, it is stated.

The inside edge of the wiper is beaded to increase the wiping effect, increase its life, and decrease the danger of tearing.

A flat metal disk is fabricated inside the outer edge so there is strength without exposed metal. There is, therefore, no metal contact to cause a fire hazard by sparks. There are no exposed bolts to catch and tear the web.

As the disk is of considerable diameter (17 in. in the larger size) it effectively protects the hole, and reduces the danger of dropping tong dies, hammers, chisels, etc., therein, the makers assert.



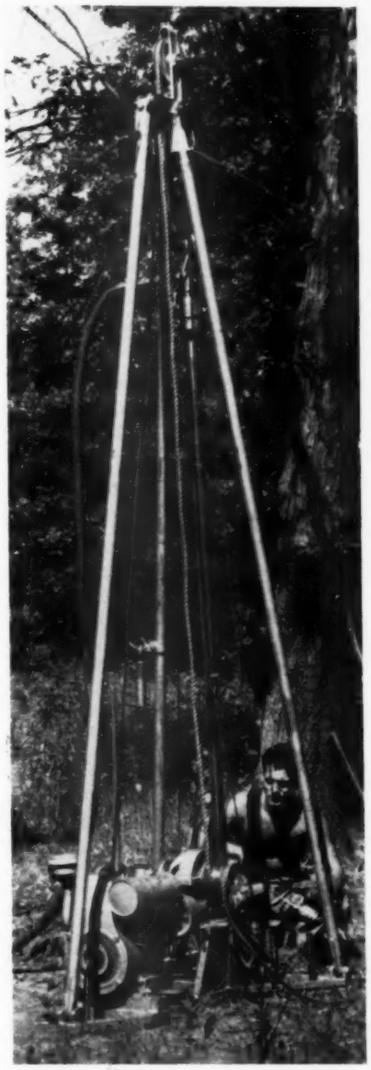
The pipe wiper is easily slipped over the drill pipe and is held down by the master bushing.

The pipe wiper is made in two sizes, the 14-in. diameter size for 2⅜-in., 2⅞-in., and 3½-in. tubing and drill pipe. The 17-in. diameter size is for pipe sizes from 2⅜-in. to 6⅝-in. diameter, inclusive.

The pipe wiper is adapted for wiping oil from tubing as well as mud from drill pipe.

Portable Rotary Shot-Hole Drill

THE Type A-3 Portable Rotary Shot-Hole Drill, manufactured by Engineering Laboratories, Inc., Kennedy Building, Tulsa, Oklahoma, was designed for the Seismograph Service



Corporation, to be used in areas where the terrain and road conditions require extreme portability.

The drill disassembles into parts easily portable, the heaviest of which is the 5-hp. gasoline engine, weighing 103 lb. No other part weighs more than 75 lb. Drill rod, 1⅝ in. O.D., commonly known as "A" rod, is used and is cut into 7 ft. lengths to make a lighter and shorter three-legged mast than would be possible with the regular 10-ft. lengths. An outside coupling is used for this drill rod that has a specially designed water swivel that permits of a 1⅛-in. water course throughout the system.

A mechanical pull-down arrangement that has proved practicable on other type machines is used. It is clutch operated and permits the application of the entire weight of the machine on the drill rod. Additional weight may be applied by having workmen stand on the base of the machine, or by piling the dirt from the slush pit on planking laid across the base of the machine.

Several types of pumping equipment are available. These weight from 65 lb. complete to 225 lb., the latter units disassembling into parts weighing not to exceed 103 lb. Choice of the unit depends upon the actual drilling problem.

All-Steel Rotary Hose

A NEW all-steel rotary hose designed to meet requirements for flexibility, strength, and service at all depths and under all pressures has been announced by H and B Sales Company, Long Beach, California.

Known as the Tri-Plane Champion, this rotary hose incorporates the use of seven high-pressure Champion swing joints and swivels connected by six lengths of seamless steel tubing and of lubricated roller bearings. The champion will swivel in any direction from any position in the rig, regardless of pressure, as it has full 360-deg. action in three different planes, the makers assert. It is light in weight, yet it is strong enough to work freely under 5000-lb. pressure without binding, springing, or vibrating. It is fluid-tight, packed-off at each joint by composition cups that expand under pressure to form a seal, it is stated. Thus, the higher the pressure the tighter this seal becomes.

An outstanding feature of the Tri-Plane Champion Hose is the tapered roller bearing construction of each swivel. These bearings are precision made and fitted to give a smooth, even bearing surface. The hose has full opening end to end, and all joints are arranged to provide a straight fluid course. No sand or fluid can reach the bearings, and there are no abrupt shoulders to obstruct fluid passage or cut the hose, it is pointed out.

Cleveland Model 140 Ditcher

JUST announced is the Cleveland Model 140, a new ditcher designed expressly for pipe-line work by The Cleveland Trencher Company, 20100 St. Clair Avenue, Cleveland, Ohio. This new ditcher will dig a trench from 18 to 30 in. wide and to 64 in. deep.

High ground clearance, foot pedal steering, and remote control shifting of main transmission are important new developments. Mounted on new high crawlers, the machine has a high-ground clearance that is especially advantageous when working over rough

right-of-way and traveling up and down grades, the manufacturer asserts.

The remote control lever on the main transmission is placed directly in front of the operator so that he can quickly and easily shift from one speed to another without taking his eyes from his work in the trench.

The differential steering that makes the machinery very flexible is controlled by foot pedals that leave the operator's hands free for lever manipulation. A slight pressure on either pedal turns the ditcher in the direction desired. Pressure applied to both pedals simultaneously acts as a positive braking system, a valuable safety feature when working in mountainous territory.

The "Cleveland 140" is powered by a 6-cylinder gasoline engine as standard equipment; however, Diesels may be obtained if specified.

Working in combination with the main 4-speed transmission is a new "multi-speed" crawler transmission that is enclosed in a steel housing, entirely anti-friction-bearing-equipped, and running in a bath of oil to assure long life and quiet, dependable operation.

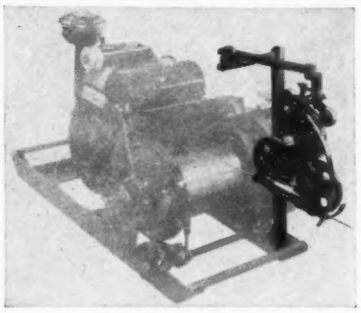
This new "Cleveland" ditcher weighs less than eight tons. It has a frame in which the X-members and trusses of modern alloy steels combine to give maximum strength and utmost rigidity with minimum weight. Boom and frame are of electric-welded construction. The boom is more than 300 percent stronger than heretofore, being of alloy-steel structural members fabricated in box-sections, the makers state.

High tractive efficiency is obtained by the use of 16-in. crawler-shoes, and the bearing pressure is reduced to 5.3 lb. per sq. in.

Measure Meter and Weight Indicator

TO measure depths accurately in oil or gas wells, by mechanical means, eliminating the factor of human error, the C. A. Mathey Machine Works, 212 South Frankfort, Tulsa, Oklahoma, has placed on the market its Type B Measure Meter and Weight Indicator.

This new device eliminates the method of "feeling" for the bottom of the hole or for an obstruction, the makers assert. Two dials, one indicating length of the line and one indicating weight on the line, show instantly when the bottom or obstruction has been reached. The dials are so situated that both can be instantly read.

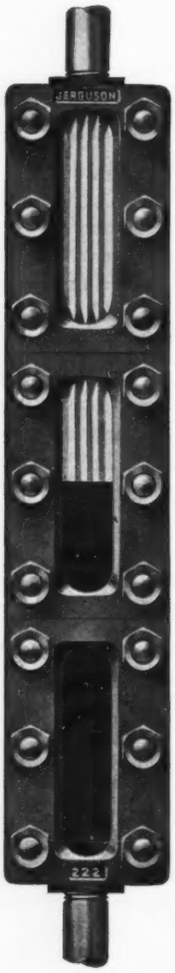


Two methods are available to determine the bottom of a well: the weight is run in the hole and when resting on the bottom the load is taken off the weight indicator, at this point the measure meter shows the depth; or the line may be run in, and the reading taken, by slowly raising the line until the weight indicator shows the point where the weight has been lifted from the bottom.

The design and weight of the Type B Measure Meter and Weight Indicator make it adaptable to all units using measure meters. This unit uses a new spring-balanced rack that it light, compact, and permits mounting in a small space, it is stated.

Type B Measure Meter is available for all cars and trucks equipped with measuring line reels driven by a power take-off, individual gas-engine-driven portable units, measuring line reel attachments on pulling units and core drills.

JERGUSON



REFLEX GAGES ARE ABSOLUTELY RELIABLE

for showing liquid levels in tanks, towers, stills, etc. Ideal for gasoline, kerosene, oil — no matter what the color of the liquid.

Easy to read because . . .

Empty space shows
WHITE

Liquid level appears
BLACK

Dependable at high and low temperatures and pressures—that means effective protection to men and equipment.

There's a JERGUSON GAGE for your plant.

Jerguson Gages are best by every real test.

Write for Catalog

JERGUSON GAGE & VALVE CO.
89 FELLSWAY
SOMERVILLE MASSACHUSETTS

Ingersoll-Rand Compressors

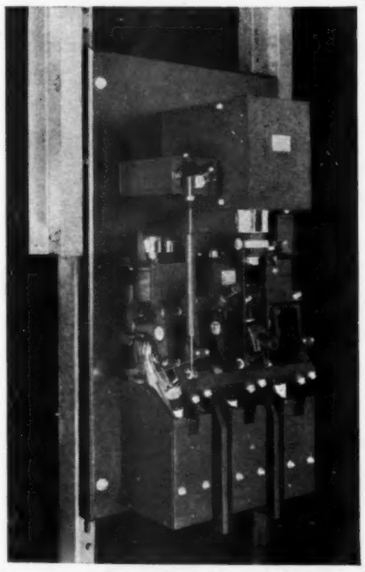
A NEW line of industrial compressors and vacuum pumps in sizes of from ¾ through 5 hp. is announced in an illustrated catalog covering the complete line of Ingersoll-Rand Type 30 Compressors. These new compressors, embodying a simplified "finger valve" construction, form only one part of the complete range of Type 30 Compressors, which are built in sizes to 15 hp. for pressures as high as 1000 lb. They are available with or without drive, receiver-mounted or bare.

Announcement is also made of new paint-spray compressor units that utilize the "finger valve" construction.

The catalog contains both installation and shop views of the machines, together with complete operating and physical characteristics of each. Copies of the booklet, form 7502-J, are available from the Ingersoll-Rand Company, 11 Broadway, New York City, or any of their branch offices.

Compact Air Circuit Breaker

APPROXIMATELY one-half the size of previous devices of the same rating is a new air circuit breaker recently announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania. Among the most important improvements in these new breakers is a "De-ion" arm chamber, a device that is simple in construction, operates on either alternating current or direct current, has long life, and under normal operating conditions requires no maintenance. It operates on any current within the range of established interrupting ratings; arcing current is limited to one-half cycle, which minimizes the noise and flash accompanying the interruption of a short circuit.

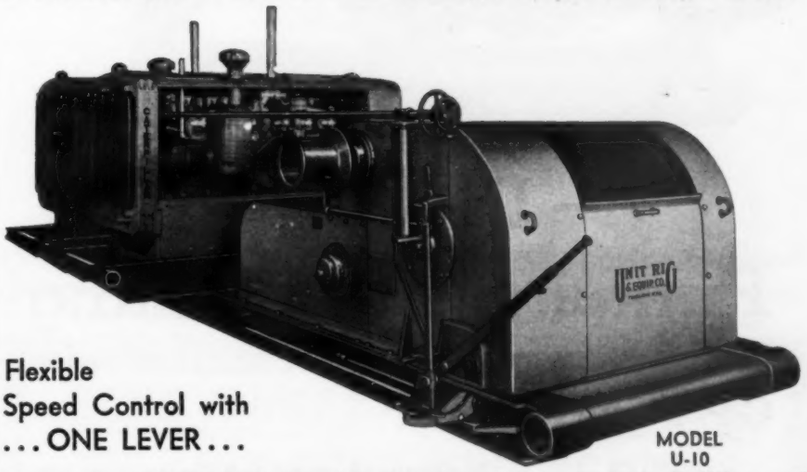


The circuit breaker itself is stronger than previous air breakers, the makers state. No carbon is used in the contacts; and the protective contact supports have been strengthened. Heavy current through the flexible conductors to contact supports causes a magnetic reaction that increases contact pressure and gives increased protection to the main contacts.

Moving parts on the solenoid mechanism have been reduced to a minimum number, the moving core of the mechanism being connected directly to the breaker operating level. The new breakers are adjustable to front-of-board, drawout, back-of-board, and separate enclosure mounting. Five sizes are available, covering a range of operating currents from 15 to 6000 amp. at 600 volts on a-c. service—15 to 10,000 amp. direct current—and have interrupting capacities of from 40,000 to 80,000 amp.

UNIT RIG EQUIPMENT

Portable "UNIT RIGS" For All Jobs

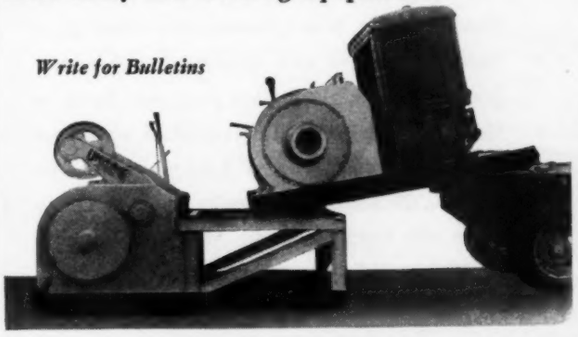


Flexible
Speed Control with
...ONE LEVER...

MODEL U-10

Outstanding UNIT RIG Portable Rotaries—for Small Hole Drilling and General Drilling Jobs of all depths "Quicker and Cheaper", and NOW, the latest utility well servicing equipment...

Write for Bulletins



This modern U-17 Service Hoist will handle all servicing work where a single drum hoist is required. It has the added feature of combining when needed, with our U-19 Auxiliary Spudder Unit to make an unusually economical and efficient two drum spudder hoist for any and all oil field service.

For the complete Unit Rig line, SEE Composite Catalog pages 2196-2197; Drilling Equipment Directory Pages 45, 46, 47.

UNIT RIG & EQUIPMENT COMPANY
TULSA, OKLAHOMA, U. S. A.

Cameron Ram-Type Tubing Control Head

CAMERON IRON WORKS, Inc., Houston, Texas, utilizing the basic principles of design of the Cameron Type CHR Control Head for high-pressure wells, has developed a new, low-cost ram-type tubing control head to provide safe, positive control while drilling-in and completing medium pressure wells, according to the manufacturer. The new control head has been designated as Cameron Type "LD".

As shown in the cross-section drawings herewith, the Cameron Type "LD" control head is unequal-flanged to eliminate the need for an adapter spool between the control head and the casinghead. Units are available in Series 600 A. P. I., 4000-lb. test pressure and Series 900 A. P. I., 6000-lb. test pressure. Flow outlets are provided above and/or below the rams as desired. The head may be flanged on the well as soon as pressure has been relieved on the oil string. Flow connections may be installed back to the separator and tanks immediately, while waiting on cement to set. All drilling-in and completion operations may then be conducted through the body of the Type "LD" control head.

On any rework or reperforating job, subsequent to original completion of a well, the ram-type "LD" control head will be found extremely practicable and convenient. Used in conjunction with a second Cameron ram-type con-

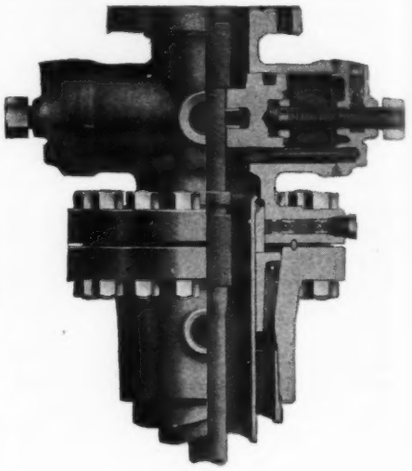


Fig. 1

trol unit, the tubing string may be raised or lowered, or pulled from the well under pressure without killing.

As illustrated in Fig. 1, the Cameron Type "LD" control head is available with an unusual means of sealing the annular space between casing strings. A Cameron Type "O" slip suspension casinghead having welding bushing above the slips is illustrated in Fig. 1. After casing has been suspended and welded to the bushing, the "LD" control head is installed and plastic packing is forced through a

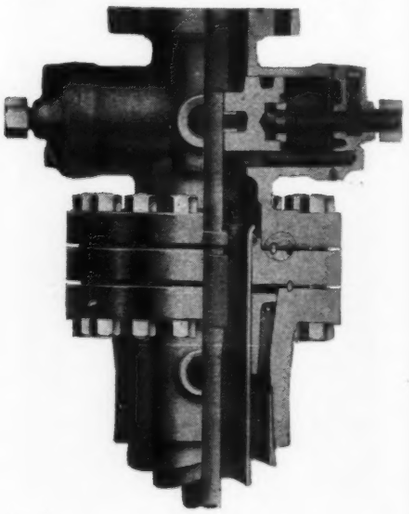
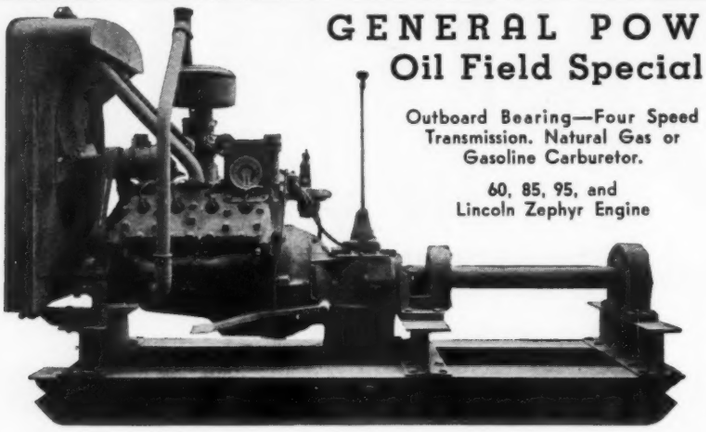


Fig. 2

port in the lower flange, causing a moulded asbestos ring, recessed in the bore of the lower flange, to seal tightly around the welding bushing.



GENERAL POWER
Oil Field Special

Outboard Bearing—Four Speed Transmission. Natural Gas or Gasoline Carburetor.

60, 85, 95, and Lincoln Zephyr Engine

– Drilling –
Pumping – Generating
in any country is more economical with
G-P Power Units

UNITS

These models are particularly adapted to oil field installations.

G—P SERIES T
For general power applications. Uses the latest type twin disc clutch.

G—P SERIES G
For general power applications where an outboard bearing is desired. Uses the large Ford truck clutch.

G—P 20 K.V.A. GENERATOR
Equipped with safety controls. 20 K.V.A. at 1200 r.p.m. with 85 h.p. engine.

Thousands of power installations are constantly proving the economy and dependability of these sturdy units. Every General Power Ford V-8 Conversion Unit is a standard power unit designed and manufactured for a particular purpose. Each of the seven models are available with four different sizes of Ford V-8 engines, 60 h.p., 85 h.p., 95 h.p., and Lincoln Zephyr. These units are available with single, dual, and multiple engine installations.

For Prices and Information — Write, Wire, or Phone

GENERAL POWER, INC.
QUAPAW, OKLAHOMA PHONE 64

Plastic packing ports are also provided around each ram thrust screw to effect a seal at those points and to obviate the need of conventional stuffing boxes. The use of plastic packing at these points makes it possible to repack under pressure at any time.

As shown in Fig. 2, the Cameron Type "LD" control head is also available without the plastic packing feature in the lower flange for use above Cameron types "M" and "J" slip suspension casingheads, or above any make of flanged casinghead. Fig 2 illustrates the Cameron Type "J" casinghead.

Compact Diesel Electric Sets

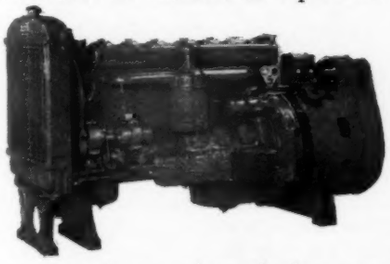
A LINE of Diesel engine-electric generator sets featuring simplicity and compactness is manufactured by the Murphy Diesel Company, 5305 West Burnham Street, Milwaukee, Wisconsin.

Standard a-c. units carry continuous load ratings of 55 kw., 85 kw., and 100 kw. Generators are supplied for 120/208-volt, 240-volt, 480-volt, 600-volt, and 2400-volt, 60-cycle, 3-phase current and for 110/220-volt, 60-cycle, single-phase circuits.

A complete factory-wired assembly of generator control instruments mounted on the generator frame eliminates the need of the conventional switchboard. Simple connections to the main-line switch complete the electrical installation.

The belt-driven exciter operating at higher than generator speed provides quick exciter response and excellent voltage regulation, the manufacturer states.

Close coupling of engine and generator, plus the fact that all generator accessories are mounted on top of the



generator frame, reduces the floor space required for the installation of these Diesel electric generator sets to the minimum.

Simple synchronizer relay equipment is provided by means of which two or more Murphy Diesel a-c. generator sets may be automatically synchronized.

As the illustration shows, all controls for both the Diesel engine and the generator are grouped to place the entire unit under the operator's fingertips at all times. All of the engine-mounted accessories including the lubricating and fuel oil filters, the fuel supply pump, the starter and starter generator, the air cleaner, and the instrument panel are shown. Only a small crankcase breather air cleaner is mounted on the other side of the unit.

D-c. generator sets for 125 and 250 volts and for capacities of 55 kw., 85 kw., and 100 kw. are of similar close-coupled design.

Mathey Specialized Equipment

•

PORTABLE MEASURING UNITS—

for any depth work, with reel capacities from 5,000 feet to 15,000 feet of .072 line. Seven models are available for mounting in trailers, cars, pulling-units, and core drills. Self-powered by gasoline engine or power take-off models. All units are sturdy and compact.

Measure Meters
Gas Testing Equipment
Reeling Equipment for Well Shooting
Oxy-Acet Pipe Beveling Machines
Designers, Manufacturers of Special Machinery

Write for Details

C. A. MATHEY MACHINE WORKS

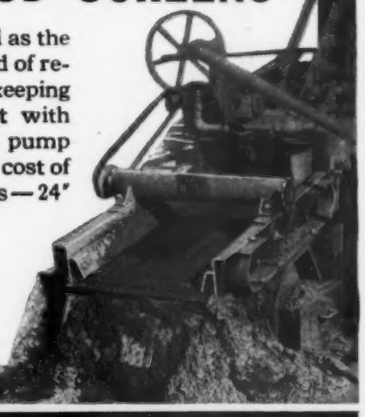
Phone 3-3623 **212 South Frankfort** **Tulsa, Oklahoma**

SAVE MONEY $ $ $ CUT COSTS
WITH LINK-BELT MUD SCREENS

● The Link-Belt screen is recognized as the most efficient and lowest cost method of reconditioning rotary mud. Besides keeping destructive materials out of contact with pump parts, thus vastly reducing pump maintenance, a valuable saving in the cost of mud is effected. Made in two sizes—24″ x 48″ and 48″ x 60″ screening areas.
Send for Folder No. 1772.

Link-Belt Company, Philadelphia, Houston, Dallas, Los Angeles, Indianapolis, Chicago, New York. Sold by most supply houses.

7748



LINK-BELT *Vibrating* SCREEN

H. B. Cookston Joins Staff Regan Forge and Engineering Co.

The Regan Forge and Engineering Company, San Pedro, California, announces that H. B. Cookston has joined its Mid-Continent Division as sales representative. His headquarters will be in Houston, Texas.

H. B. COOKSTON

Cookston has been active in virtually all Mid-Continent and eastern oil areas for the last 25 years and during recent years has been affiliated with the W-K-M Company, Houston, Texas.

Hughes Tool Company Announces Promotions

The Hughes Tool Company, Houston, Texas, has announced the following promotions in its engineering department:

F. L. SCOTT

F. L. Scott has been made director of research, having been in charge of rock bit development for the last 22 years. Scott graduated from Texas A. & M. College, receiving a bachelor of science degree in mechanical engineering in 1914, and joined the engineering staff of Hughes Tool Company in 1917.

RALPH NEUHAUS

Ralph Neuhaus, assistant chief engineer for the last three years, has been promoted to chief engineer. Neuhaus graduated from Cornell University with a degree of mechanical engineering in 1918 and entered the Hughes engineering department three years later. He has seen 18 years' continuous service with the company.

L. E. GARFIELD

L. E. Garfield has been advanced to the position of assistant chief engineer after 13 years in the Hughes engineering department. Garfield graduated from Rice Institute in 1926, receiving a bachelor of science degree in mechanical engineering.

S.A.E. Meeting in Tulsa, Oklahoma, November 2-3

Brigadier General George H. Brett and Colonel A. W. Herrington will be the principal speakers at the meeting of the Fuels and Lubricants Division of the Society of Automotive Engineers, scheduled for November 2 and 3 at the Mayo Hotel, Tulsa, Oklahoma. The former is chief of the Materiel Division, U. S. Aviation Corps, and will speak on "The Present Trend in Design and Size of Military Aircraft." Colonel Herrington is president of Marmon-Herrington Company and an authority on foreign armaments.

According to B. E. Sibley, Continental Oil Company, and general chairman of the meeting, the program is of unusual and timely interest. Other papers scheduled include, "Oil Industry Power," by Prescott C. Ritchie, Waukesha Motor Company; "Vaporization Characteristics of Motor Fuels," by Alden, Trimble, and Blair, Phillips Petroleum Company; "Power Applications for the Movement of Earth," by J. M. Cavies, Caterpillar Tractor Company; and "Hypoid Lubricants," by C. F. Prutton, Case Institute, Cleveland, Ohio. A feature of the November 3 evening session will be a debate between engineering students of Kansas State University and the University of Oklahoma on the subject: "Resolved: That V-Type Engines are to be Preferred to In-line Engines for Passenger Car Equipment."

Gas-Lift Production Conference

A gas-lift production conference will be held November 9, 10, and 11 at College Station, Texas, under the direction of the School of Engineering, Department of Petroleum Engineering, A. and M. College of Texas. A series of lectures will be given by S. F. Shaw, consulting engineer and a special lecturer of the Department of Petroleum Engineering.

Petroleum Accountants Elect Officers and Directors

The Petroleum Accountants Society opened its 1939 activities by holding a meeting in Tulsa, Oklahoma, on September 28, when officers were elected to serve for the ensuing year, and three directors were elected for a three-year term. R. B. Hanson was elected president; B. E. Witchell, first vice-president; L. E. Tustison, second vice-president, and Norman C. Cross, secretary and treasurer. The newly elected directors are: R. B. Hanson, B. E. Witchell, and Norman C. Cross. There are nine on the board and the six directors holding over are, E. B. Branson, L. P. Harrington, A. W. John, E. H. Loosley, L. E. Tustison, and W. H. Massey.

Works New Cameron Sales Manager

Madden T. Works has been named sales manager for Cameron Iron Works, Inc., Houston, Texas. Works

MADDEN T. WORKS

received a mechanical engineering degree from Rice Institute in 1931. After four years of service in the engineering department of Abercrombie Pump Company, an associated company, he joined the Cameron engineering staff as assistant chief engineer.

J. M. TEAGUE

J. M. (Red) Teague has been appointed assistant sales manager. Teague, who has served as sales representative for his company since 1937, will make his headquarters in Houston.

Frank Crow, a member of the Cameron engineering department, will fill the position of assistant chief engineer.

A.P.I. Accident-Prevention Committee Awards Safety Certificates

Eleven new million-hour safety certificates have been presented to plants and departments of U. S. oil companies by Axtell J. Byles, president, American Petroleum Institute—bringing to 64 the total of million-hour awards given since the formal recognition of these safety records was begun in November, 1938. The awards were announced by H. N. Blakeslee, American Petroleum Institute, secretary of the Institute's Accident-Prevention Awards Committee; Byles is chairman of the committee.

The million-hour award certificates are given to oil-company plants, departments, or sub-departments for accident-prevention records of 1,000,000 or more man-hours with no disabling injuries. Many of the latest awards were made shortly after completion of the required million hours, although no accident had occurred to terminate the record period.

M. L. Stirling Joins Dowell Staff

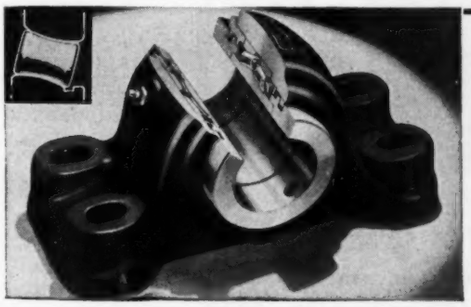
Dowell Incorporated, announces the appointment of Marshall L. Stirling as a member of its general staff in Tulsa, in the capacity of sales engineer.

Stirling has a wide acquaintance in the oil industry, having been associated with it for many years. He went with Dowell June 1 from The Gas Lift Corporation where he served as sales manager in Houston, Texas. Prior to his connection with the Gas Lift Corporation he was field engineer and assistant to the general superintendent of the natural gas and gasoline department of Magnolia Petroleum Company in Dallas.

M. L. STIRLING

Stirling will be closely associated with R. D. Shaw, sales manager, acting as special account representative and sales supervisor for outlying districts.

Renew Your Subscription



It's so SIMPLE. but what an Improvement!

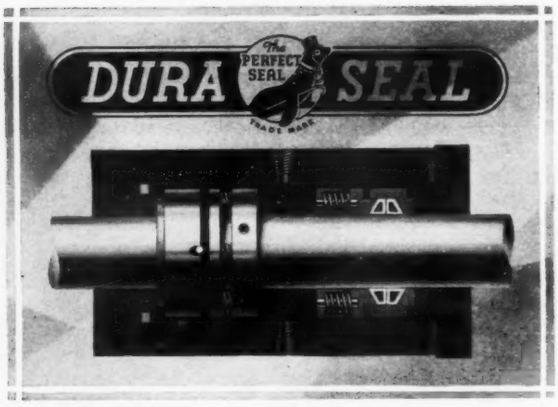
● In the Link-Belt Shafer pillow block the spherical inner race is free to move in any direction to adjust itself to misalignment, inaccuracies of installation, or follow shaft deflection without altering contact of rollers or disturbing the bearing action in any way. This assures normal and efficient bearing operation under all conditions.

The concave rollers placed at an angle between convex raceways carry any type of load equally well. The thrust load is transmitted to the normal rolling contact surface and since there is no need for auxiliary means for taking the thrust there is no possibility of rollers pinching and binding. Link-Belt Shafer roller bearings are available with or without mountings. The mounted units are in several types, such as—pillow blocks, cartridge units, flanged units, take-up units, hanger units, etc. Send for 272-page Data Book No. 1600.

LINK-BELT COMPANY 7863-B

CHICAGO INDIANAPOLIS PHILADELPHIA DALLAS
HOUSTON LOS ANGELES NEW YORK

SEND FOR NEW POWER TRANSMISSION DATA BOOK



A Mechanical Seal

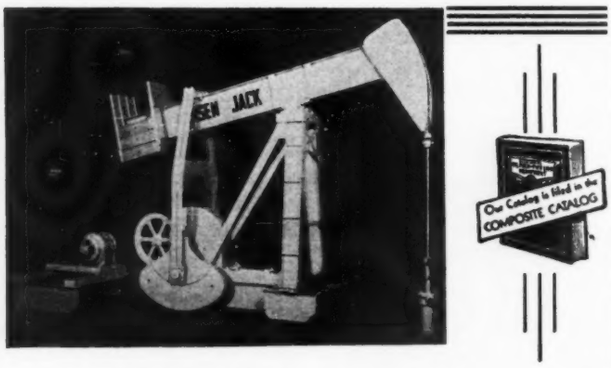
That Rotates with the Shaft

A perfected seal for centrifugal or rotary pumps and agitators working corrosive or gritty fluids. Petroleum Light Ends (Propane, Butane, etc). Crude Oil, Chemicals and practically any condition not satisfactorily sealed by ordinary packings are now held with DURA SEAL.

Friction surfaces of DURA SEAL are reduced to about one-sixth those of conventional packings. No shaft wear ... no sleeves needed ... reduces fire hazard ... power costs cut.

FREE ENGINEERING COUNSEL ON YOUR PACKING PROBLEMS
Write for literature and specification sheets

DURAMETALLIC CORPORATION
The PERFECT SEAL
KALAMAZOO MICHIGAN



In ANY Language!

JENSEN Units save money in any language at any depth under any conditions. Men in foreign fields who never had any real confidence in other pumping equipment have found great satisfaction in the amazing dependability of JENSEN Jacks, product of 20 years of close application to one problem.

What JENSEN Units can do for him is an interesting story with a profitable climax for any producer in any country.

JENSEN BROTHERS MANUFACTURING CO.

. . . . . *Coffeyville, Kansas*

EXPORT OFFICE 136 LIBERTY STREET, NEW YORK

Ray Sheehan, Well-Known Pipeliner, Passes Away

R. J. SHEEHAN

R. J. Sheehan, Tulsa, Oklahoma, president of the Sheehan Pipe Line Construction Company, died of a heart attack in Houston, Texas, on September 19. He was taken from the train and rushed to a Houston hospital upon returning from Beaumont where he had been on business for several days. He had been in good health and members of the family expressed the belief that the heart attack was a result of acute indigestion. Burial was in Tulsa.

Sheehan went to Tulsa in 1914 from his birthplace, Bradford, Pennsylvania. In Tulsa he joined his father in the pipeline construction business. In 1917 he joined the United States army and served overseas. Upon his return he settled in Bradford and returned to Tulsa in 1922 and he and his brother John B. Sheehan formed the Sheehan Pipe Line Construction Company.

Survivors are his widow, Madeline Sheehan, Tulsa; six children, Mary Madeline, Ruth, Raymond, Jr., Patricia, Jeanne, and Michael, all of the home; three brothers, Walter J. Sheehan, John B. Sheehan, and Frank N. Sheehan, all of Tulsa; and four sisters, Mrs. M. E. Horrigan, Miss Helen Sheehan, Miss Kathleen Sheehan, and Miss Rosemary Sheehan.

Gulf Coast Refiners Association Adopts Specifications

The Gulf Coast Refiners Association, having headquarters at 1613 Second National Bank Building, Houston, Texas, George Reid, executive secretary, announces that its recently adopted specifications for GCRA standard motor fuels, kerosene, gas oils, and Diesel gas oils are available in permanent printed form.

The association recently announced adoption of standard specifications for quality products to expedite trading, to facilitate quotings on markets, and to avoid confusion in interchange and publication of market information. The specifications cover summer and winter grades of motor fuels, both leaded and unleaded. The standard motor fuel is a 400 end point product having specifications applicable through the octane rating grades of 65, 68, 70 and 72-74 (CFR method), all unleaded, and a GCRA 72-74 (CFR) standard leaded motor fuel. The published specifications give complete details relative to distilling points, minimum and maximum end point, recovery, doctor, corrosion, gum, Reid vapor pressure, etc.

The GCRA standard kerosene specifications adopted include coverage of such items as gravity, flash, end point, doctor, corrosion, color, sulphur, and burning tests. The GCRA gas oil, or heating oils, are specified as straight run products. The association specifications for Diesel gas oils include the usual Diesel index classifications, and such materials are all straight run products.

This action by the association in adopting definite speci-

fications for certain products, does not mean that the association member companies will not continue to produce other grades of the various products mentioned to meet market demands where necessary. Standard quality products, however, which are sold under the association seal and permit number system and under GCRA specifications as to quality, will conform to the standards adopted by the group. Copies of the new specifications can be obtained by writing association offices or member companies.

The Gulf Coast Refiners Association, which was organized late in June, 1939, consists of ten non-integrated refining companies operating in the Gulf Coast area in Louisiana and Texas. D. W. Hovey, vice-president and general manager, Republic Oil Refining Company, Houston, is president of the association. Cornelius Kroll, president, Southport Petroleum Company, Houston; and G. L. Rowsey, president of the Coastal Refining Company and the Taylor Refining Company, Taylor, Texas, are vice-presidents. L. F. Rothermel, president, Maritime Oil Company, Houston, is treasurer. Directors, in addition to the above, include Kent W. Bartlett, president, Amsco Refining Company; Saul Singer, president, Pontiac Refining Corporation; S. S. Seltzer, Sr., president, Southwestern Oil and Refining Company; T. E. McArdle, president Terminal Refining Corporation, all of Corpus Christi, Texas, and D. B. Williams, president Chalmette Refining Company, New Orleans, Louisiana.

A.P.I. 20th Annual Meeting at Chicago November 13-17

The Twentieth Annual Meeting of the American Petroleum Institute, largest national trade association of the petroleum industry, will be held November 13 through 17 at the Stevens Hotel, Chicago, Illinois. Group sessions of the Institute's three divisions—Production, Refining, and Marketing—two general sessions of the entire membership, meetings of the Board of Directors and Board of Councillors, and more than 50 meetings of committees and subcommittees are scheduled for the five-day gathering.

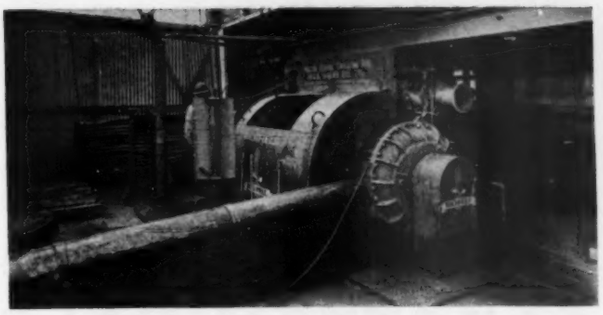
The final program has not yet been completed; but according to preliminary plans, Monday and Tuesday, November 13 and 14, entirely will be devoted to separate and joint sessions of the various Institute committees. The Board of Directors will meet three times, on November 14, 15, and 16. The Board of Councillors will nominate candidates for election to the Board of Directors in a morning meeting November 15, the election taking place at a general session the afternoon of the same day. A second general session of the entire membership will be held the afternoon of November 16.

Group sessions of the Divisions of Production, Refining, and Marketing are scheduled for the morning of November 16 and for all day November 17. The annual dinner and entertainment will take place the evening of November 16.

A preliminary program, with details of committee meetings and speakers at group and general sesssions, will be announced as soon as plans have been completed.

Atlas Opens Two New Supply Stores

Atlas Supply Company announces the opening of two new supply stores, one at Artesia, New Mexico, the other at Grayville, Illinois. H. F. Oliver, manager at Kermit, Texas, for several years is in charge at Artesia, where the company carries both cable tool and rotary supplies, as well as pumping units. The Grayville store is under the management of E. L. Chavellier, who managed the company's Overton, Texas, store for several years. The Grayville store carries a complete line of rotary supplies and pumping equipment.



11,004 FEET WITH A WILSON TITAN RIG!

Powered by two Wilson 350 HP. gas engines

Richfield K.C.L.No.1 Is Deepest Well Ever Drilled with Internal Combustion Powered Mechanical Rig.

Wilson sets another record and ENSIGN Carburetion Equipment was right there doing its part.

ENSIGN Gas and Butane Carburetors are the standard of the oil industry.

The Wilson Manufacturing Company, Inc., of Wichita Falls, Texas, and its exclusive California Distributor, H. & B. Sales Company, Ltd., of Long Beach are customers of

ENSIGN

WIND ELECTRIC

CATHODIC PIPE LINE PROTECTION PLANT

Pipe line operators and corrosion engineers! Here is a plant that will supply ample electricity throughout most western states for the satisfactory prevention of pipe line corrosion. Hundreds are in use by many of the leading Pipe Line Companies throughout America and Foreign countries. More than 10 years of proven service in generating electricity has proven the reliability of these plants under all weather conditions.

Never a burned out generator. Guaranteed against burn-out. Patented construction and design. Large 14 ft. propeller, controlled by flyball variable pitch governor. Available for all ground resistance from .08 ohm to 2.0 ohms. Manufactured in two sizes, 1250 watts and 2000 watts.

Write for Complete Literature!

AMERICA'S OLDEST MANUFACTURER OF WIND ELECTRIC PLANTS

JACOBS WIND ELECTRIC CO., INC.

PIPE LINE DIVISION • MINNEAPOLIS, MINN.

DOWN GO PRODUCTION COSTS
UP GOES SAFETY

. . . when you install the New

OTIS removable BOTTOM HOLE REGULATOR

Our own extensive field tests . . . and now . . . reports from satisfied users show that the new Otis Removable Bottom Hole Regulator is the safest and most economical device built for the variable control of high-pressure withdrawals.

This proven tool adds *surface controlled* rate of withdrawal to the advantages of bottom-hole choking.

It makes possible a wide range in rate of production . . eliminates freezing at the surface controls *without* expensive surface heaters. It keeps pressures down in the tubing—off the surface connections. In some cases it reduces cutting and lowers gas/oil ratios.

Write today for information on how the New Otis Removable Bottom Hole Regulator may solve one of your high-pressure production problems.

WRITE OR CALL TODAY

OTIS "Don't Kill Your Well" Call OTIS

Look under Oil Field Service in the yellow pages of your telephone directory for nearest Otis representative.

OTIS PRESSURE CONTROL, Inc.
Dallas, Texas

Branches: Houston, Texas; Hobbs, New Mexico; Oklahoma City, Oklahoma.

Paul Shuman Elected Member Board Atlantic

At a meeting of the board of directors of The Atlantic Refining Company, Paul Shuman, treasurer of the company, was elected to membership on the board. Shuman entered the employ of The Atlantic Refining Company in 1920 as an accountant in the controller's office. He was elected assistant treasurer of the company in 1929 and treasurer in 1937.

Sand-Banum Appoints Distributor

Western Sand-Banum Company, 703 M. & M. Building, Houston, Texas, distributors for Sand-Banum products in the Gulf Coast territory announces the appointment of Service Machine and Iron Works of New Orleans, Louisiana, as their distributor in that territory. This new distributor will carry a full warehouse stock of "Sand-Banum", the pure colloidal concentrates developed for the control of scale and corrosion in boilers and engines.

Food Machinery Corporation Purchases Pump Company

Announcement is made by the Food Machinery Corporation, from their Los Angeles, California, offices, of the purchase of Kimball-Krogh Pump Company, a division of the Victor Equipment Company. The Food Machinery Corporation are manufacturers of deep-well pumping equipment through their Peerless Pump Division and Kimball-Krogh will now be merged into another pump manufacturing unit of the corporation.

Vernon Edler, vice-president of Food Machinery Corporation, handling the negotiations for this company, stated that the merger will enable the corporation to offer an entirely new line of pumps in addition to the regular Peerless line that comprises the Peerless Turbine Pump, the Peerless Propeller Pump, and the Peerless Hi-Lift Pump.

In discontinuing the manufacture of its various pump lines, the Victor Equipment Company, through its president, L. W. Stettner, stated that in view of the constantly expanding activities in the welding division, their company will now be in a better position to concentrate their efforts in the development and sale of Victor welding products.

Pyramid Equipment and Sales Company Formed

Formation of the Pyramid Equipment and Sales Company is announced by Gilbert Woodill, to manufacture and sell carburetors and fuel regulators for the use of natural gas in power units and stationary engines. These same carburetors and a combination vaporizer and fuel regulator for the use of liquefied petroleum gas (butane-propane) are also available for such engines, as well as tractors, trucks, buses, rail cars, and portable oil-well drilling and servicing units. The carburetors will be available in both straight gas and combination gas and gasoline types in S.A.E. sizes to 2 in.

Woodill is president and general manager and Karl Westlund is vice-president and chief engineer of the company. Both men were associated with the Ensign Carburetor Company for approximately ten years.

In addition to the manufacture and sale of carburetting equipment, it is announced that the company will act as manufacturers' agents for the sale of kindred devices and equipment made necessary by the conversion of engines to dry gas use. They will operate in the Pacific Coast, Mid-Continent, and southern Rocky Mountain areas.

The Pyramid Equipment and Sales Company is at 2305 East Eighth Street, Los Angeles, California.

Death Calls J. W. Van Dyke, Chairman Atlantic Refining Company

J. W. VAN DYKE

J. W. Van Dyke, 89, chairman of the board of The Atlantic Refining Company, whose career in the oil industry virtually coincides with the life of the industry itself, died recently after an illness of several months. Death occurred in Philadelphia.

Being of an adventurous spirit and ambitious, young Van Dyke, at the age of 17, left his family home in Mercersburg, Franklin County, Pennsylvania, where he had attended the common schools and later Tuscarora Academy. The lure of the oil fields was too strong. From that time until his death, progress marked the steps of the man who eventually became a business associate and close friend of John D. Rockefeller, Sr. Van Dyke was one of the "self-made" business leaders of America, and for 70 years that business was oil and its by-products.

Rector Appoints Lucey Export Representative

L. L. Rector, president, Rector Well Equipment Company, Fort Worth, Texas, announces the appointment of Lucey Export Corporation, 3505 Woolworth Building, New York City, as export representative, following his recent return from a ten-day business trip to New York. Aside from a complete line of casingheads, tubingheads, and special casing and tubinghead flanges, this new arrangement will give direct distribution in foreign fields to Rectorseal, for preventing leaks in threaded and gasket connections, and Rectorkote, for preventing corrosion.

Lucey Export Corporation maintains foreign offices at Broad Street House, E.C. 2, London, England; Calle Defensa 320, Buenos Aires, Argentina; 58 High Street, San Fernando, Trinidad, B.W.I.; and Str. Vasile Lupu No. 13, Ploesti, Roumania.

S. A. Knisely Appointed A.B.P. Executive Vice-President

By the unanimous vote of the executive committee and the sub-committee with which it worked on the matter of appointing Judd Payne's successor, Stanley A. Knisely, advertising manager of Republic Steel Corporation, was offered the post of executive vice-president of the Associated Business Papers, Inc., which he has accepted. He assumed the executive management of A.B.P. on October 1.

Knisely entered upon his business career as a cub reporter on the Canton, Ohio, *Daily News*. In 1917 he resigned the position of managing editor to accept the telegraph editorship of the *Cleveland Plain Dealer* and, following the war, was made city editor. After ten years in the reportorial and editorial departments of these two newspapers, Knisely gave up this work to become assistant secretary of the National Paving Brick Manufacturers Association. In 1927 he resigned and took over the duties of director of advertising and research of the National Association of Flat Rolled Steel Manufacturers. In 1934, after 12 years as a trade association executive, Knisely joined the Republic Steel Corporation.

KINK OF THE MONTH "in the interests of more efficient cleaning"

HEAT EXCHANGE EQUIPMENT NOW CLEANED FASTER

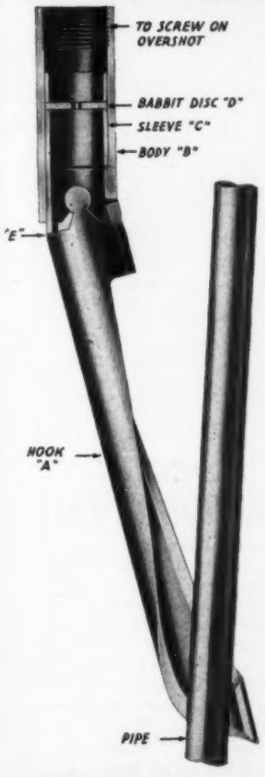
To get rid of those sludge deposits that so seriously cut down the heat transfer capacity of your exchangers, put efficient, economical Oakite cleaning to work for you.

The first thing you will notice is that Oakite cleaning is thorough ... more complete sludge removal will show itself in better exchanger performance. But it is lower in cost, too! No disassembly of equipment is required. Just circulate solution of the Oakite material recommended for your work ... that's all there is to it!

Manufactured only by:
OAKITE PRODUCTS, Inc.
48 Thames Street New York, N. Y.
Representatives in all principal cities of the United States.

OAKITE 1909 1939 30

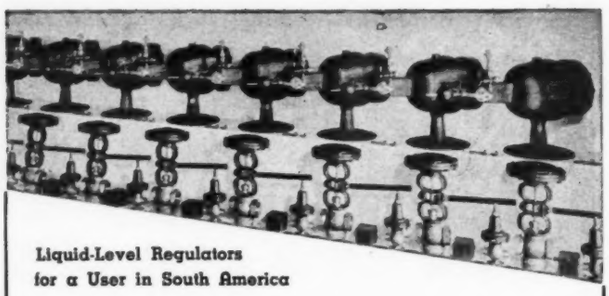
OAKITE Certified CLEANING
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT



Brauer
IMPROVED HYDRAULIC
Wall Hook

This popular tool is used extensively for hooking pipe from walls of hole and for guiding the overshot over the fish. Designed to run on bottom of overshot, it will permit passage of *pipe or tool joint thru* it to the overshot above. This tool differs from all others in that there is no pull thru the hinging knuckles.

Brauer
MACHINE & SUPPLY CO.
OKLAHOMA CITY, OKLA.
P. O. Drawer 1469 Phone 2-3014



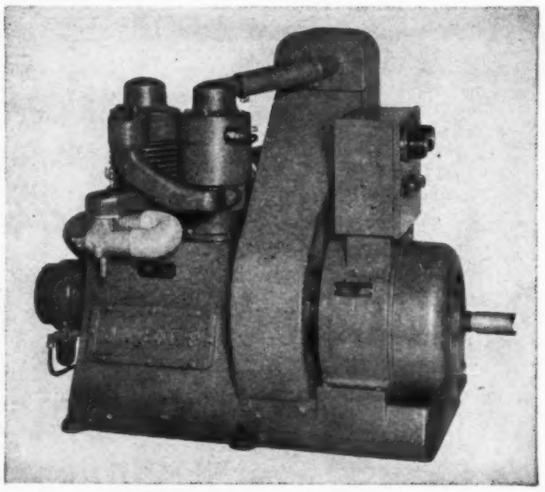
Liquid-Level Regulators
for a User in South America

These Regulators Are Ordered in "Flocks"

The C-F Vigilant Liquid-Level Regulator has so wide a range of usefulness and does what it is designed to do so effectively that customers often find occasion to order a number at one time. In cracking stills, bubble towers, vaporizers, and the like, liquid levels are perfectly maintained by use of such regulators. Ask for Bulletin 3113—also new catalog of C-F Regulators for all requirements of pressure-control.

The CHAPLIN-FULTON MFG. CO.

28-40 PENN AVE. CF PITTSBURGH, PA.



JACOBS SPECIAL CATHODIC UNIT

Engineered *exclusively* for the cathodic protection of Pipe Lines. Two years in development, Heavy Duty, Slow Speed, Few Moving Parts, No Valves, Gears, Belts or Pumps to wear out and cause trouble. Unequaled in long life, and freedom from attention. Gas or Gasoline operated. The patented design and construction of this entire engine unit was developed by our engineers. It is manufactured complete in our factory (not an assembled plant with engine or generator built by different companies).

Write for Complete Literature Today

The JACOBS WIND ELECTRIC CO., Inc.

PIPE LINE DIVISION • MINNEAPOLIS, MINN.

Book Reviews

Lubricants and Lubrication by James I. Clower. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York. First edition, 1939. 464 pp., 332 figs. Price, $5.00.

This book has been written to fulfill the need of users of lubricants and of machine designers for a knowledge of the source, production, refining, and theory of lubricants. The author has endeavored to develop only those phases of the subject that have not been so fully treated in other books. Purposely omitted, therefore, are exhaustive studies of production and refining of crude oil and of the mathematical theory of lubrication as these subjects are fully covered by several available good books.

The first 11 chapters are devoted to the fundamentals of lubricants and lubrication and apply to all types of machinery and industry. The next six chapters cover in detail the lubrication of steam turbines, steam engines, air compressors, refrigerating machines, and all types of internal-combustion engines. The last chapter points out general principles and proper practices for storing and using lubricants.

Annual Reviews of Petroleum Technology, Vol. 4 (covering 1938). F. H. Garner, General Editor. Published by The Institute of Petroleum, The Adelphi, London, England. August, 1939. Pp. viii and 480, 20 illustrations and diagrams. Price, 11 shillings ($2.70 in U.S.A., postage paid).

This book affords an excellent survey of progress in the science and technology of petroleum during 1938. The 28 chapters cover virtually every branch of the industry. The authors of the various chapters are authorities on the subjects reviewed.

Perhaps the greatest single value of the book is in its correlation of developments abroad as well as in the United States. Thus all major improvements of other countries may be studied and reviewed by those in the industry in this country who do not have access to foreign literature.

Accidents in The Petroleum Industry of Oklahoma in 1937, Summarized and Compared with 1923, by C. F. McCarroll. U. S. Bureau of Mines Report of Investigations No. R.I. 3446, May, 1939.

The report analyzes the accident record of Oklahoma in a manner that brings out the tremendous costs resulting from accidents and, in these terms, shows the benefits derived from the advances in the application of safety measures since 1923.

The average cost per accident has increased because of more stringent regulations governing compensation but the number of accidents in Oklahoma's petroleum industry has decreased from 3728 in 1923 to 2195 in 1937.

Nowery J. Smith Distributor for Grant Tools

Nowery J. Smith Supply Company, Houston, Texas, has been appointed exclusive Mid-Continent distributor by Grant Oil Tool Company, Los Angeles, California.

The Smith organization has its headquarters in Houston and branch service plants at New Orleans, Louisiana, Rodessa, Louisiana, Shreveport, Louisiana, and Corpus Christi, Texas.

The Grant line of oil tools has world-wide distribution. The company is best known as the builders of the Grant Roller Cutter Underreamer or hole enlarger.

Facilities for complete 24-hour service at each of its five establishments have been arranged, according to Nowery Smith.

TRADE LITERATURE

BAROID SALES DEPARTMENT, National Lead Company, Los Angeles, California, has issued a booklet on the Baroid Well Logging Service. The booklet is comprehensive in its scope and is well illustrated. Copies will be sent free upon request to the Baroid Sales Department.

ENGINEERING DATA covering gas lift for small productivity wells have been compiled and published in a comprehensive booklet for production engineers and superintendents in the oil industry. The booklet is a most complete treatise on automatic intermitting. Included are the following steps for flowing small productivity wells, that will no longer make their daily allowables: (1) Through explanation of gas-lift problems; (2) How it works; (3) Parts and equipment necessary for installation; (4) How to install, and (5) Case history of gas lift in the South Texas area and results obtained over 12 months of constant operation.

This new booklet is free upon request to the Merla Tool Corporation, Dallas, Texas.

ARMSTRONG BROS. TOOL COMPANY, Chicago, Illinois, announces a new (No. C-39) general catalog of all Armstrong lines, which include; "Armstrong" tool holders; carbon, chrome-vanadium, and detachable head socket wrenches; "C" clamps; lathe and milling machine dogs; turret lathe and screw machine tools; ratchet drills; bits, blades, and high-speed steel; setting-up tools; machine shop specialities, and "Armstrong Bros." pipe tools.

AN IMPRESSIVE 24-PAGE PRESENTATION of the features of the Buckeye Clipper Convertible Excavator has been issued by The Buckeye Traction Ditcher Company, Findlay, Ohio. Special attention is given to the patented Buckeye "Mevac" metered vacuum power control system for all operations.

Other details of design and construction are also covered fully and the adaptability of the machine shown by action pictures of jobs in progress. The Buckeye Clipper is built in three sizes: ½-, ⅝-, and ¾-yard capacities, convertible to: shovel, trenchhoe, crane, clamshell, dragline, and pile driver. "Mevac" power control is used on all models.

THE WHITNEY CHAIN AND MANUFACTURING COMPANY, Hartford, Connecticut, has issued the new Whitney V-135 Silent Chain Drive Catalog. This book gives complete information for the selection and design of silent chain drive. Catalog V-135 includes 64 pages of engineering data, dimensions, horsepower ratings, and sprocket data, as well as illustrations of typical drives in various industries.

A 12-PAGE ILLUSTRATIVE BOOKLET describing "The New Improved Method of Conditioning Rotary Drilling Mud" is divided into three sections. The first deals with desanding of rotary drilling mud and the second part outlines the concentrating of mud-weighting materials. The booklet further goes on to depict the new, compact, light-weight, and readily transportable, Merco Centrifugal Desander.

Copies of this booklet may be obtained without obligation from Merco Centrifugal Company, Dept. C, 343 Sansome Street, San Francisco, California. The manufacturer would greatly appreciate your mentioning *The Petroleum Engineer* when sending in your request.

YOU CAN ELIMINATE

1.—Working Barrels
2.—Seating Nipples
3.—Mechanical Shoes and the
4.—Pulling of Tubing

by installing the

B-M-W ADMORE
Insert Pump Anchor

(Patent No. 2027783)

And in addition you will save on sucker rods and other equipment where high fluid level permits the well to be pumped above bottom. The cost is insignificant when compared with the savings effected.

How does it do it? By seating the B-M-W ADMORE Liner Barrel, Fluid-Lifter Pump, or other Insert Pumps, at any desired point in the tubing. It ingeniously packs off and holds down directly in the tubing itself in the most advantageous pumping position.

See our advertisement in the "Composite Catalog." Or, better still, write for complete data.

SUPPLY STORES SELL THEM

Also other B-M-W Products: ● TEX TYPE Plunger Fittings and Valves; ● NEILSON Tools (Safety Sucker Rod Hooks, Rod Elevators, Sucker Rod Sockets, etc.); ● BALLS and SEATS (made for every pumping service) including the TOWER TYPE Ball and Seat and the 2-WAY NON-MAGNETIC Crown; ● ADMORE Liner Barrels; ● COLLINS Belt Clamps; ● FLUID-LIFTER Pumps; and ● NU-TEX Pumps and Valves.

BRADFORD MOTOR WORKS INC.
OIL WELL SUPPLIES
BRADFORD, PA. — TULSA, OKLA.

KINK OF THE MONTH
"In the interests of more efficient cleaning"

NOW EASIER TO RID ENGINE WATER JACKETS OF SCALE AND RUST

When rust and scale build up . . . engine efficiency goes down. Cooling is retarded. Pistons are apt to stick, cylinder walls scored. Overheating causes oil consumption rise. There is less power output.

To safely rid your gas and oil engines of costly scale and rust accumulations in water jackets, just circulate a solution of quick-acting Oakite Compound No. 32 through the cooling system. Rust and scale deposits are quickly dissolved. Follow with a water rinse, and water jackets are left clear and clean

Get all the facts on easy, low-cost Oakite cleaning. Write today.

Manufactured only by:
OAKITE PRODUCTS, Inc.
48 Thames Street New York, N. Y.

Representatives in all principal cities of the United States.

OAKITE 1909 1939 30

OAKITE Certified CLEANING
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Brauer

JUNK BASKET

Designed to run on bottom of drill pipe, the Brauer Junk Basket has proved an extremely efficient aid in picking up scrap iron, hammers, cones and other debris from hole.

The debris is lifted with the mud —not against the flow, as it is attempted to do with several other makes of baskets.

Once thru the rubber trapping device, the junk is caught. You do not have to depend on metal clapper or fingers to close behind debris in order to catch it.

Repairs to this tool can only entail putting in a new rubber.

Brauer

MACHINE & SUPPLY CO.

OKLAHOMA CITY, OKLA.

P. O. Drawer 1469 Phone 2-3014

CARLYLE "RAT HOLE"

Formation Tester Packer Elements

⅜ Tapered Style 1

Full Tapered Style 3

Replacement Packer Elements are now available for *all* makes and *all* styles of Rat Hole Formation Testers.

Why risk delay by using distorted elements—or waste time and money making slip-shod replacements when you can get them, custom built for *your* Tester?—and not ordinary Packer Elements, No Sir!

Carlyle Packer Elements are made from the finest vulcanized Rubber and Fabric discs. They're finished to a smooth cone shape, and precision tooled to insure accurate tapers for positive Rat Hole seating. A straight center hole (to size required) is maintained from top to bottom, and O.D.'s are machined to exact size (usually 1" smaller in diameter than Main Hole or casing I.D.) to allow for drilling fluid displacement as Tester is being lowered into main hole.

We can furnish replacement Packer Elements for any Tester, shipped the same day order is received. Just send us the make and style, or your own drawings for quotations.

Write today for full price list and special export discounts.

Carlyle Packer Element on Formation Tester. ⅔ Tapered Style 2

CARLYLE RUBBER COMPANY, INC.

62 Park Place New York, N. Y.

Oil Field Rubber Specialties

Albert Pranger to Specialize in Developing New Tools for Guiberson

ALBERT PRANGER

The Guiberson Corporation, Dallas, Texas, has announced that Albert Pranger, who has served the company in capacity of chief engineer for four years, will henceforth engage in special field research, the purpose of which will be to discover from actual field research, opportunities for improving the present equipment manufactured by The Guiberson Corporation and to find and develop new oil-field tools.

The business of The Guiberson Corporation, since its founding in 1910, has been essentially that of developing, introducing, and perfecting oil-field equipment. Pranger's work will definitely organize the company's search and development of new oil-field specialties, placing its effort in this direction on the basis of a consistent and continuous program. His headquarters will be at the company's main office at Dallas.

R. W. Yerkes Retires as Treasurer Link-Belt, Succeeded by Harry Kellogg

At a recent meeting of the board of directors of Link-Belt Company, Richard W. Yerkes tendered his resignation as secretary-treasurer. Harry E. Kellogg, who has been closely associated with him for the last 18 years, has been elected his successor. Successively, Kellogg has held the positions of plant accountant, general credit manager, and chief accountant.

F. V. MacArthur, formerly assistant secretary, was elected secretary. Melbourne P. Anderson, formerly general credit manager, has been appointed chief accountant to succeed Kellogg. C. W. Marum, for 28 years a member of the company's New York office, has been named general credit manager to succeed Anderson.

R. B. Kelly to Illinois for Pure Oil Company

Raymond B. Kelly, manager of the Fort Worth, Texas, division of Pure Oil Company, has been named manager of the Olney, Illinois, division of that company. R. W. McIlvain, Jr., previously stationed in Illinois, replaces Kelly in Fort Worth.

Dowell Incorporated Announces Changes In Its Tulsa Sales Office

J. H. (Jack) Finney, formerly station manager for Dowell Incorporated at Midland, Texas, has been transferred to Tulsa as sales engineer. Finney is taking over the former duties of Jas. L. Coss who has been transferred to the research department.

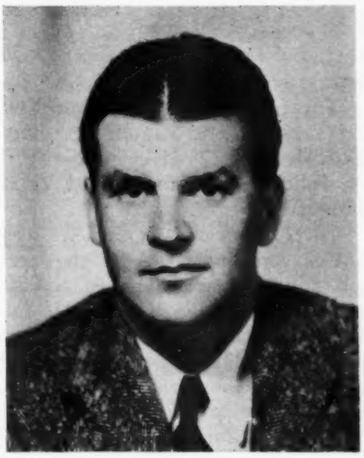
George Morris Catches Some Big Ones

Recently, George Morris, president of the Bradford Motor Works, Bradford, Pennsylvania, attended a meeting of the company's field representatives in Galveston, Texas, at which

time a deep-sea fishing trip was made. The accompanying picture shows part of the catch. In the picture are George Morris; George Iverson, Kilgore; S. G. Colbaugh, Shreveport; J. K. Carter, San Antonio; L. L. Thomas, C. D. Berry, and G. J. Goodson, Tulsa; E. B. Smith, Wichita Falls, and J. E. Burton, Midland.

Agency Man Heads Industrial Advertisers

Martin R. Klitten of The McCarty Company, Los Angeles advertising agency, has been elected president of the Southern California Chapter of the National Industrial Advertisers' Association. Other officers of the association are Sam Eastman, vice-president; K. L. Tate, secretary-treasurer, and Don Mack and Richard O'Mara, directors.



MARTIN R. KLITTEN

The association is promoting industrial advertising for Southern California's industries in trade journals, general magazines, and newspapers.

Look for the *Arm-and-Hammer*

ARMSTRONG BROS.

PATENTED IMPROVED PIPE VISE AND SADDLE

Light, compact, strong, over-capacity, this is the Chain Vise to take on the Job. One-piece jaw prevents the bending of smallest pipe under chain—permits a tight hold. Jaw, base and handle are drop forged steel; screw is alloy steel. The pipe Vise Saddle attaches instantly to any square or round post. It provides a solid base for chain or hinged vises at the point of work.

Write for Catalog

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

331 N. FRANCISCO AVE., CHICAGO, U. S. A.

RIDGID

The **ONLY** pipe wrench that guarantees you a repair-proof housing

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free.
COPR. 1939 THE RIDGE TOOL CO. ELYRIA, O.

WORK can't break that housing—nor warp it. You waste no time or money on repairs. Adjusting nut can't bind, always spins easily in all sizes, 6" to 60". Powerful replaceable slip-proof chrome molybdenum jaws, handy pipe scale on hookjaw. Comfort grip I-beam alloy handle. No wonder millions prefer the RIDGID. For economy and easier work, buy it at your Supply House . . . today!

THE RIDGE TOOL CO. • ELYRIA, OHIO

ROCKFORD CLUTCHES

Do The EXTRA Heavy Work . . . in Oil Fields

14" Over-Center Clutch

Power Take-Off

Rockford Industrial Clutches are made with single or double drive plates, for operation in oil or dry, in many sizes for transmitting up to 80 h. p. at 100 r. p. m. Rockford Power Take-Offs, with O-C Clutches, fit standard S. A. E. flywheel housings. Investigate.

Outstanding in economical heavy-duty service on power units, tractors, auxiliary drives, and similar uses, Rockford Industrial Clutches have many oil field applications. Accurate and rugged in construction, they provide smooth, quick, positive control, easy operation, great durability. Rockford Industrial Clutches are made in two types . . Over-Center, which locks in or out of engagement, and Spring-Loaded, which works like an automobile clutch. For money-saving dependability, specify Rockford Industrial Clutches in your power equipment. Write for information.

Rockford Drilling Machine Division

Borg-Warner Corp., 1303 Eighteenth Ave., Rockford, Illinois, U.S.A.

No Need To Wildcat!

The TEXAS STATE HOTEL is a "Proven Area" . . . . . .

At HOUSTON'S oil headquarters there is no "pro-ration" of smiling service.

When you stop at the TEXAS STATE you enjoy a convenient downtown location; quiet cool air-conditioned comfort; and good meals in the famous Silver Grill or Mezzanine Dining Room.

Completely Air-Conditioned

The

TEXAS STATE HOTEL

HOUSTON

B. F. ORR, Gen'l Mgr.

YOU will enjoy the friendly atmosphere of Tulsa's most homelike and genial hotel. Whether you stop for a day, a month, or a year every effort will be made to render gracious, prompt, and unobtrusive service in such a way as to make you want to "Come Again."

• **Rates** from $2.50 •

Hotel TULSA

HOLLIS H. HODGES MANAGER

TULSA, OKLAHOMA

"Doug" Brown President of O.C.S. Organization

At a special meeting held at the company's headquarters in Coffeyville, Kansas, Douglas R. Brown, for 20 years vice-president of the company, was elected president of the O.C.S. Manufacturing Company, succeeding W. P. Turner of Long Beach, California. At the same meeting, attended by high officials of the Parkersburg Rig and Reel Company, formal transfer of the O.C.S. common stock to Parkersburg was made, following approval by a meeting of the stockholders of the latter company.

Other new officers announced are Don C. Myers, former secretary-treasurer and now vice president-treasurer of O.C.S.; B. M. Farson, secretary, and Van Frey, former office manager, assistant secretary. The new board of directors, in addition to Brown, Farson, and Myers, includes John M. Crawford and C. A. Ruf. Crawford is chairman of the board of the Parkersburg firm, of which Ruf is vice-president and general manager, and Farson is secretary-treasurer.

DOUGLAS R. BROWN

Turner retired from the board of directors as well as the presidency. C. B. Morton continues as district manager of O.C.S. at Tulsa, Oklahoma. No further changes in personnel or policies are contemplated at this time, according to Brown.

The Parkersburg acquisition of the common stock of the O.C.S. company is one of the largest and most important oil industry transactions in recent months, involving approximately a million and a half dollars. The two companies will continue to operate as separate concerns under their present individual policies. Officials of both companies stated that the transaction just consummated would enable the two companies to better serve the oil and gas industry.

O.C.S. maintains manufacturing plants at Coffeyville, Kansas, Houston, Texas, and Long Beach, California, specializing in drilling and pumping equipment.

Joseph Reid Gas Engine Company Reorganizing

Reorganization and new financing plans of the Joseph Reid Gas Engine Company, Oil City, Pennsylvania, have been developed to a stage whereby they will become operative in the very near future. The plans provide for the McKenna Brass and Manufacturing Corporation, Millersburg, Pennsylvania, to purchase the plant and all the assets of the present company.

The new company, operating under the name of the Joseph Reid Gas Engine Corporation will be amply financed and will continue the operation of the plant at Oil City, it is announced. It will manufacture the present line of gas and oil engines, transmission equipment, geared and band-wheel pumping powers, and reduction pumping units.

The new company will also add to the products now manufactured, improved designs of pumping machinery for the oil industry.

MEETINGS

National Safety Congress and Exposition—October 16, 17, 18, 19, and 20, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

National Stripper Well Association—October 17, Fort Worth, Texas.

Independent Petroleum Association of America, Tenth Annual Meeting—October 18, 19, and 20, Fort Worth, Texas.

American Institute of Mining and Metallurgical Engineers, Petroleum Division—October 19 and 20, Los Angeles, California.

Western Petroleum Refiners Association, Regional Technical Meeting—October 27, Washington-Youree Hotel, Shreveport, Louisiana.

California Natural Gasoline Association—November 2, Richfield Building, Los Angeles, California.

American Petroleum Institute, 20th Annual Meeting—November 13, 14, 15, 16, and 17, Stevens Hotel, Chicago, Illinois.

American Institute of Chemical Engineers—November 15, 16, and 17, Providence, Rhode Island.

American Society of Mechanical Engineers—November 4, 5, 6, and 7, Philadelphia, Pennsylvania.

Petroleum Electric Power Association, Eleventh Annual Conference—December 14 and 15, Texas State Hotel, Houston, Texas.

American Association of Petroleum Geologists, Annual Meeting—April 10, 11, and 12, 1940, Stevens Hotel, Chicago, Illinois.

American Petroleum Institute, Eastern District, Division of Production—April 11 and 12, 1940, Columbus, Ohio.

National Petroleum Association, Semi-Annual Meeting—April 18 and 19, 1940, Cleveland Hotel, Cleveland, Ohio.

International Petroleum Exposition—May 18, 19, 20, 21, 22, 23, 24, and 25, 1940, Tulsa, Oklahoma.

Third World Petroleum Congress—June 9, 10, 11, 12, 13, 14, and 15, 1940, Berlin, Germany.

Ensign Carburetor Announces Changes

RALPH G. ABBOTT

Ensign Carburetor Company, Ltd., announces the following changes in personnel:

Robert R. Wyker, who has been assistant to the president, will, in addition to his other duties, assume the position of sales manager, making his headquarters at the main office in Huntington Park, California. Wyker has been with the Ensign organization for the last five years.

Ralph G. Abbott becomes the branch manager at the Dallas branch. Abbott also has had several years of experience with the Ensign Carburetor Company. Roy Mylander, formerly in the Dallas territory on sales work, will be in charge of field service, having his headquarters at the factory. His duties will include the compiling of information that will be of help to the users of Ensign equipment.

Gotkool

WATER CANS & COOLERS

GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today!

GOTT WATER COOLER
Made in 3, 5, 8, 10, and 20 gallon sizes.

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

GOTT WATER CAN
Made in 1, 2, 3, 5 and 10 gallon sizes

KEEP PURE DRINKING WATER ALWAYS HANDY

"The Helping HAND"

"The Entirely Different Boiler and Engine Treatment"

Sand-Banum is "the helping hand" that oil operators have welcomed "with open arms." They know this pure colloidal concentrate to be a real saver of time . . . an aid to efficiency . . . and a protector of profits!

Sand-Banum is the scale and corrosion eliminant for boilers and engines that comes in 16-oz. cans—*ready to use!* Each can safely protects a 250 Hp. boiler for a month regardless of the operating conditions or the nature of the water used. Like all "good friends" it has proven tried and true.

TRY THIS FRIENDLY OFFER—Use it in your own equipment for 30, 60 or 90 days. Then if you are not satisfied—*you pay us nothing!* Write today and let it help you!

AMERICAN SAND-BANUM COMPANY, Inc.
9 Rockefeller Plaza **New York City**

VICTOR

Heat Treated
Alloy Steel Studs
for Flanged Fittings and Valves

Precision machined from steels that exactly meet your specifications and requirements, VICTOR *Heat-Treated Alloy Steel Studs* come in all standard and special sizes.

VICTOR'S central location permits speedy direct shipment — days closer in emergencies.

Write for Catalog or quotation on VICTOR STUDS *and all types of Bolts, Nuts, and Screws of high strength alloy steels or corrosion and heat-resisting, stainless steels.*

VICTOR PRODUCTS CORPORATION
2643 Belmont Avenue **Chicago, U.S.A.**

MILLER

WILL *increase* YOUR OIL CHECKS

You will be surprised at the increased oil "runs" after a MILLER Sand Pump has cleaned out the sand and sediment that is holding back production... *That's why the* MILLER *is in World-Wide use!*

The MILLER is made in diameters of 2½, 3, 3½, 4, 4¼, 5, 5½, 7 and 9 inches and lengths of 20, 25 and 30 feet. 5/32-inch wall thickness in REGULAR Type, ¼-inch wall tubes HEAVY Type Sand Pumps.

INTERCHANGEABLE BOTTOMS

To Meet Every Condition

● **BAILER BOTTOM**

With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.

● **SAND BOTTOM**

Used when tools are run and when well is shot to quickly remove loose material.

● **STAR BOTTOM**

Used for cutting the sand loose.

● **CHISEL BOTTOM**

(In Pump)

With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

Write for Descriptive Folder and Price List

See Pages 1564-65 COMPOSITE CATALOG

MILLER Sand Pump Co.

General Offices and Factory:

OKLAHOMA CITY, OKLAHOMA

1524 S.E. 29th — P. O. Box 4518 — Tel. 7-6884

Branches:

SAPULPA	KILGORE	HOUSTON
Okla.	Texas	Texas
Tel: 341	Tel: 545	Tel: P-2841

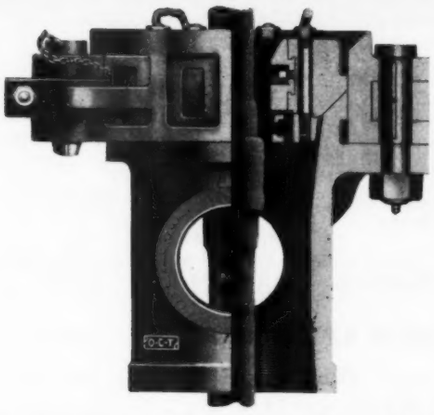
FOR SALE BY SUPPLY STORES EVERYWHERE

INDEX *to* ADVERTISERS

Abercrombie Pump Co. 218G
Air Reduction Sales Company 60
American Cable Division of American Chain & Cable Co., Inc. ..... Inside Back Cover
American Chain & Cable Company, Inc. ..... Inside Back Cover
American Hammered Piston Ring Division .....
American Manganese Steel Division of The American Brake Shoe and Foundry Company .....
American Meter Co. 6
American Pipe & Steel Corporation .....
American Roller Bearing Company 109
American Rolling Mill Co. 229
American Sand-Banum Co., Inc. 249
American Steel & Wire Co. 19
Armstrong Bros. Tool Co. 247
Axelson Manufacturing Co. 215
Baash-Ross Tool Co. 155, 156, 157
Baker Oil Tools, Inc. 171, 172, 173
Baroid Sales Co. 133
Bartlett-Hayward Division .....
Bethlehem-International Supply Co. 225
Bethlehem Steel Co. .....
Braden Steel Corp. 100
Bradford Motor Works, Inc. 245
Brauer Mch. & Supply Co. ..... 243 and 246
Brewster Company, Inc. 119
Broderick & Bascom Rope Co. 40
Byron Jackson Co. 175, 176, 177, 178
Cameron Iron Works 134-135
Carlyle Rubber Co. 246
Carson Machine & Supply Co. 213
Cavins Company 137
Chaplin-Fulton Mfg. Co., The 244
Chapman Valve Mfg. Co., The 64
Chiksan Tool Company 112
Clark Bros. Co. 92-93
Cleveland Trencher Co. 223
Climax Molybdenum Co. .....
Continental Emsco Co. 160-161
Continental Supply Co., The 160-161
Cook, C. Lee, Mfg. Co. 201
Crane Co. .....
Crum-Brainard 114
Dearborn Chemical Co. 218
Diamond Chain & Mfg. Co. 101
Dowell, Incorporated 15
Durametallic Corp. 240
Ensign Carburetor Co., Ltd. 241
Fluid Packed Pump Co. 140-141
Frick-Reid Supply Corporation 1
Gaso Pump & Burner Mfg. Co. 89
Gearench Mfg. Co. 195
General Power, Inc. 236
Gott, H. P., Mfg. Co. 249
Gray Tool Co. 47
Guiberson Corporation 87
Halliburton Oil Well Cementing Company ..... Back Cover
Harrisburg Steel Corporation 58
Hazard Wire Rope Division of American Chain & Cable Co., Inc. .....
Houston Oil Field Material Co. 103
Hughes Tool Company 210F-210G
Hunt Tool Company 187
Hyatt Bearings Division, General Motors Corp. 3
International Derrick & Equipment Co. 197
International Harvester Company 37
International Petroleum Exposition 102
Jacobs Wind Electric Co. ..... 241 and 244
Jarecki Mfg. Co. .....
Jeffrey Manufacturing Co. 98
Jensen Bros. Mfg. Co. 240
Jerguson Gage & Valve Co. 234
Johnston, M. O., Oil Tools, Inc. 143
Johnston, M. O., Oil Field Service Corp. 207
Jones & Laughlin Steel Corporation, Gilmore Wire Rope Division 2
Kinzbach Tool Co., Inc. 111
Koppers Company .....
Lane-Wells Co. 185
Larkin Packer Co., Inc. 62
Layne & Bowler Co. 189
Leschen, A., & Sons Rope Co. 9
Lincoln Electric Co. 33
Link-Belt Company 121, 237, 239
Lone Star Cement Corp. 39
Lucey Boiler & Mfg. Corp. 117
Lufkin Foundry & Machine Co. 35
Lunkenheimer Co., The 231
McEvoy Company 210A
McKissick Products Corp. .....
MacClatchie Mfg. Co. 204
Macwhyte Company 66
Marley Co. 218
Martin Decker Corp. 148-149
Mathey, C. A., Machine Works 237
Merco Centrifugal Co. 183
Merco Nordstrom Valve Co. 49-50
Metric Metal Works 6
Miller Sand Pump Co. 250
Mission Mfg. Co. 167, 168, 169
National Supply Companies, The 95
National Tube Co. 13
Oakite Products, Inc. ..... 243 and 245
Oil Well Supply Co. 85
Otis Pressure Control, Inc. 242
Parkersburg Rig & Reel Co. 227
Patterson-Ballagh Corporation 218H
Penberthy Injector Co. 11
Petroleum Electric Power Club 90
Petroleum Rectifying Co. 181
Petty Geophysical Engineering Co. 210C
Pittsburgh Equitable Meter Co. 49-50
Price, H. C., Co. 192
Rector Well Equipment Co. 191
Reda Pump Company .....
Reed Roller Bit Company 151, 152, 153
Regan Forge & Engineering Co. 217
Republic Steel Corp. 42-43
Ridge Tool Co. 247
Rockford Drilling Machine Div. 247
Roebling's Sons Company, John A. 45
Schlumberger Well Surveying Co. 83
Security Engineering Co. ..... Front Cover and 146
Seismograph Service Corp. 129
Shaffer Tool Works 163, 164, 165
Skinner, M. B., Co. 123
Smith, A. O., Corp. 131
Smith, E. M., Company 218F
Spang Chalfant, Inc. 199
Spang & Company 139
Sperry-Sun Well Surveying Co. .....
Texas State Hotel 248
Toledo Pipe Threading Machine Co. 222
Tretolite Company ..... Inside Front Cover
Trinity Portland Cement Co. 4
Tulsa Hotel 248
Twin Disc Clutch Company 20
Union Wire Rope Corp. 125
United States Rubber Export Co., Ltd. 127
Unit Rig & Equipment Co. 235
U. S. Steel Corporation Subsidiaries 13, 19, 85
Victor Products Corp. 249
Visco Products Company, Inc. 145
Western Geophysical Co. 211
Westinghouse Electric & Mfg. Co. .....
Williams Bros-Bechtel Co. 192
Wilson Supply Co. 17
W-K-M Company 203
Wyatt Metal & Boiler Works 5
Youngstown Sheet & Tube Co. 159
Zink, John, Co. .....

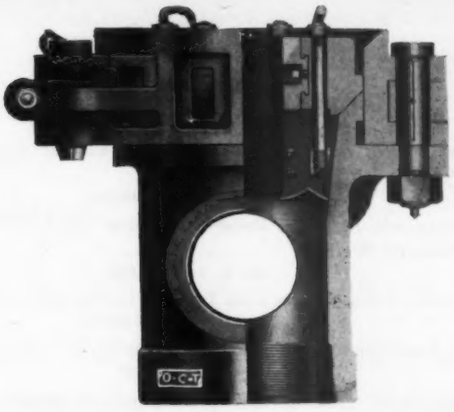
WHETHER YOU ARE RUNNING PIPE OR DRILLING AHEAD —

Just to be DOUBLY *sure*



O-C-T TYPE "D" PREVENTER WITH STRIPPER RUBBER

The O-C-T Stripper Rubber Type Blowout Preventer illustrated above provides the safest and quickest means of running drill pipe, casing, or tubing under pressure. The scientifically designed stripper type pack-off, which readily interchanges with the regular type pack-off in all types of O-C-T Preventers, passes pipe collars yet effectively seals in well pressures. The unusual performance and dependability of O-C-T Stripper Type Preventers has been definitely proven under the most adverse conditions. A number of operators have tubed as many as six 7500-ft. wells with a single stripper rubber without signs of leakage or failure. Full particulars on the complete line of O-C-T Blowout Preventers will be sent on request.



O-C-T TYPE "D" PREVENTER WITH REGULAR PACK-OFF

The O-C-T Type "D" Preventer with regular pack-off has long been a favorite with safety-conscious operators who rely upon its sound design to provide an all-important secondary seal above a ram type preventer. With the pack-off in the locked position, drill pipe may be rotated constantly as long as desired, or raised and lowered between tool joints to prevent sticking while circulating heavy mud to subdue kicking well pressures. Thus, the comparatively inexpensive O-C-T pack-off, which may be quickly and easily replaced, relieves the packers in the ram type preventer of all wear that would ordinarily be imposed upon them. Further, by alternately opening and closing the ram type preventer and the O-C-T Preventer, the drill pipe may be pulled or run into the hole under pressure.

O-C-T Blowout Preventers are available threaded and with outlets as shown, or flanged and less outlets as desired. Write for the complete O-C-T Catalog.

O-C-T MANUFACTURES A COMPLETE LINE OF CONTROL EQUIPMENT FOR DRILLING AND PRODUCING WELLS

Export Representative: Val A. Wittick, Jr.,
30 Rockefeller Plaza, New York, N. Y.

OIL CENTER TOOL CO.
QUALITY O-C-T PRODUCTS
HOUSTON, TEXAS, U·S·A

Selling Through Leading Supply Stores